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TOOLS FOR TEAMS

A HANDBOOK FOR QUALITY IMPROVEMENT

COLORADO BLM: FOLLOWING THE PATH TO QUALITY

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I: INTRODUCTION

SECTION I: INTRODUCTION

The intent of "Tools for Teams" is to provide Colorado quality improvement teams (QIT), our Quality Council, and Quality Boards, with a guide to the "nuts and bolts" of quality improvement. This handbook is designed to be used as a class manual and reference. It may also serve as a resource for teams, or anyone interested in TQM, who has not yet had the benefit of training but needs to know where to begin.

A key to successful quality management is measurable, therefore, demonstrable improvement. TQM related measurement principles and tools are essential to your process improvement efforts. "Tools for Teams" may serve as one of many resources to help guide you and to remind you of the wide array of tools at your disposal. A bibliography of other references that can be borrowed from the TQM office is included at the end of this document.

The loose-leaf format and division of the manuscript into sections reflects the TQM philosophy that everything is open to improvement. Your comments, suggestions, and information about new tools will enrich this "work in progress." Please let us know how you like "Tools for Teams", and how well it works for you.

We wish to recognize the contributions of Monica Weimer, the editor and major contributor, who saw the need for this Handbook and made it her M&L Project in 1993; BLM New Mexico, which shared material from their Process Action Team Users Guide; and our TQM tools instructor Joseph R. Tunner who made sure we got it right.

II: COLORADO
TQM PHILOSOPHY

SECTION II: WHAT IS THE COLORADO TQM PHILOSOPHY?

THE TOTAL QUALITY MANAGEMENT POLICY

The Colorado Bureau of Land Management is committed to applying the principles and operating practices of Total Quality Management to resource management and to meeting the needs of its diverse customers. Total Quality Management (TQM) is a strategy for continuously improving performance at all levels of our organization. The following definitions have been adopted for this organization:

Total Quality Management:	**A strategy that focuses all resources (people, money, time, and space) on exceeding the needs and realistic expectations of all our customers through continuously improving products and services.**
Quality:	**Pride in our work products. Doing the right thing right the first time and treating all our customers with professional concern and fairness.**
Customer:	**Anyone that receives the product of your work efforts. Customers include your co-workers, leaders, suppliers, and the public.**

TQM is a long-term journey that changes the culture of an organization and the way it conducts its internal and external business. The change to our culture will not be accomplished overnight. Only dedicated employees and managers who are willing to invest time and resources and who are willing to educate themselves on ways to improve their organization will make it work. TQM means working collectively to resolve problems in an environment of mutual responsibility. It works by identifying problems, assessing possible solutions, and taking corrective actions without laying blame for past mistakes. Those persons directly involved in providing the products and services are those who will most likely be recommending and making the needed changes and reaping the many benefits.

The following TQM principles and operating practices have been adopted by our organization:

ORGANIZATIONAL GUIDING PRINCIPLES:

- Employees are the source of our strength and provide the means by which we may achieve excellence in our products and services.
- We must operate as a team. Employee involvement is essential.
- External and internal customer involvement in all phases of our improvement processes will ensure progress in achieving our goals.
- Excellence must become a way of life for everyone.
- We will document our process and share our successes.

TQM PRINCIPLES:

- Achieving customer satisfaction.
- Making continuous improvement in products and services.
- Involving the entire work force in quality.

OPERATING PRACTICES:

- Top management provides leadership and support.
- TQM is integrated into BLM's strategic plans.
- The focus is on external and internal customers.
- Effective communication and trust are established.
- Employees are empowered and teamwork is fostered.

- ▹ The quality of products and services is systematically measured.
- ▹ Up-front quality assurance is established.
- ▹ Employee training and recognition is ongoing.

THE BLM COLORADO VISION

BLM Colorado began its drive for excellence and quality quite a while ago. In a series of team meetings over the past few years, our managers and leaders focused on developing our mission, vision, and long-term goals. At the Colorado Management Conference in November, 1991, the Management Team decided to involve the entire work force in a commitment to quality using TQM principles and practices. As a result of that meeting they published a mission statement, a vision, and a set of long-term goals for BLM Colorado:

BLM Colorado Mission Statement:

Serving people through progressive stewardship of the public lands.

The Vision:

- BLM is the authoritative source of accurate and reliable land and resource information for use by the public and by BLM.
- BLM manages conflict and is a catalyst for building coalitions among local and national interest groups to make the best public land decisions. BLM embraces public-private partnerships to expand capabilities to better manage the public land and its resources.
- BLM has a diverse, competent and proactive work force empowered by common visions, that operates in a progressive human resource environment. This work force is supported by an organization that is capable of quickly responding to change.
- BLM manages public lands consistent with sound ecological and environmental principles to meet the natural resource needs of society.

- ▹ The quality of products and services is systematically measured.
- ▹ Up-front quality assurance is established.
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- BLM manages public lands consistent with sound ecological and environmental principles to meet the natural resource needs of society.

- Individual commitment to quality customer service is the hallmark of Colorado BLM.

- BLM achieves continuous improvement through evaluation of the impacts and effectiveness of its decisions.

- The public understands the extent to which natural resources contribute to the quality of human life, including commodity needs and aesthetic values.

Long-term Goals:

- BLM Colorado focuses on customer service, employee involvement, and continuous improvement by using Total Quality Management (TQM) principles.

- BLM Colorado employs process improvement to enhance efficiency, decision-making, and productivity.

- BLM Colorado is an organization that has the optimum skill mix at appropriate locations to effectively and efficiently pursue our visions to accomplish our mission.

- BLM Colorado values the benefits of work force diversity and is responsive to the diverse needs of employees.

- BLM Colorado uses outreach, education, and partnerships so that employees and the public become part of the visions for Colorado.

III: TEAM WORK

SECTION III: TEAM WORK

PART 1: WORKING AS A TEAM

Individuals become team members with a variety of distinct expectations, experiences, and values. These differences affect how they will relate with each member of the team. Behaviors in groups center around either the personal values held by each individual or the sociological values of the newly combined group. The behavior of the group will be modified whenever these values move in and out of areas of conflict and harmony. Experience has shown that people work most effectively when they can experience what they value.

Frequently, the obstacles people experience in the work place can be traced to conflicting values held by the employee and the requirements of the work environment. When people are in a team situation, they bring those conflicts to the meetings with them. Resolution of such conflicts must occur if the team is to succeed.

To reduce conflict and develop more productive team members we need to recognize that different values are held by each individual, and structure teams to meet as many of the identified values as possible. A team is likely to become dysfunctional if the member's needs are not addressed and met. Our goal should be to recognize different individual values, not to attempt to change these values.

While some assignments are best accomplished by individuals, many tasks are more conducive to the work performed by a team. Benefits of working on a team include:

* a wider knowledge base
* more perspective regarding the problem
* increase in creativity
* more buy-in from those affected by the decision when they participate in developing the solution.

Closely monitoring the group dynamics of a team is a continuous process. Every time the team meets, the members will bring new experiences to the team which could affect the way they interact. Teams progress through predictable stages of group development with specific behaviors associated with each new stage. It is the task of the facilitator and team leader to identify the individual behaviors and determine how they will affect the goals of the team.

One of the first team-building tasks encountered by a newly-formed team is to establish guidelines called ground rules for how the group will operate and behave. When these guidelines are not consciously established by the group, members become aware of them only through trial and error.

In order to avoid unproductive confusion, it is important that groups decide consciously how they would like to behave and operate as a group. By deciding early in the group process to establish ground rules, groups can clearly outline how they would like to behave and operate as a successful group.

A few examples of ground rules that teams may want to consider are:

- Team problems are everyone's responsibility.
- Team time belongs to the team - no outside interferences.
- No derogatory comments or put downs allowed.
- Treat everyone with respect at all times.
- Ask questions.
- Listen to understand.

TEAM OPERATING PROCEDURES

Operating procedures are procedural and logistical norms. These include the arrangements for meetings and the work processes the team will follow to fulfill its responsibilities. Establishing such norms early in the life of the team will reduce the amount of time needed at each meeting to identify who is responsible for certain items and tasks.

The team starts developing its framework and operating procedures by looking at certain basic issues during the first organizational meeting. The issues include:

1. How often do we meet?
2. When do we meet?
3. Where do we meet?
4. How long will the meeting be?
5. Who will be responsible for the tasks of the team? (i.e. Recorder, Minute Keeper; see "Part 2: Roles" below)

STAGES OF GROUP DEVELOPMENT

A Quality Improvement Team is a group effort. The team members must work together effectively if they are to identify and solve the problems before them. Trying to accomplish a task through a group rather than individually has certain advantages:

→ an increase in the amount of information that is available
→ a wide pool of skills and knowledge
→ a great variety of approaches and ideas

Difficulties may also arise. Hidden concerns, like undercurrents, pull team members away from their obvious task. Gridlock might eventually occur. Such undercurrents can inhibit a group's chance of becoming an effective team. Every group should spend some time on activities, not directly related to their assigned task, that will build understanding and support in the group.

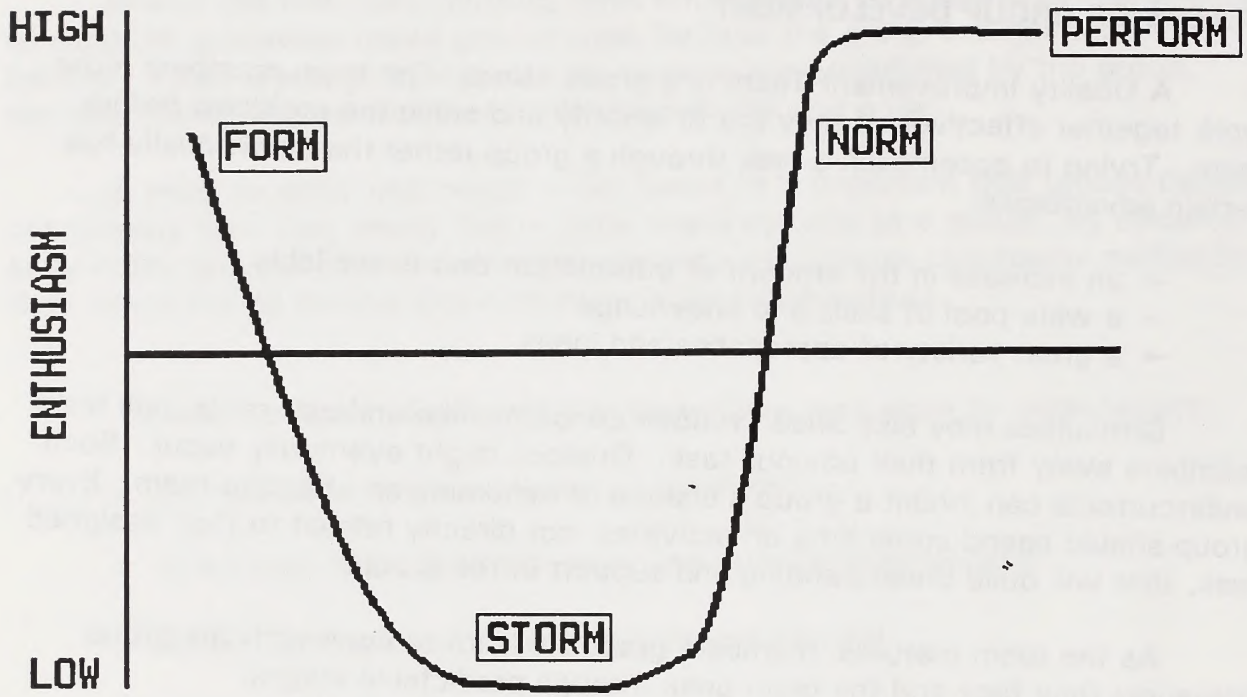
As the team matures, members gradually learn to cope with the group pressures they face and the team goes through predictable stages.

Stage 1: The Form Stage

When a team is forming, members cautiously explore the boundaries of acceptable group behavior. This is a stage of transition from individual to team member identity, and of formally and informally testing the leader's guidance. This period is characterized by team members demonstrating that they need to be included, want to be heard and want to have their individual concerns addressed.

Many different feelings and behaviors may occur at this stage. They might include:

- initial tentative attachment to the team
- suspicion, fear, and anxiety about the job ahead
- attempts to define the task and decide how it will be accomplished
- discussion of concepts and issues
- complaints about the organization, the process, and barriers
- discussion of symptoms or problems
- attempts to determine acceptable group behavior and how to deal with group problems
- decisions on what information needs to be gathered



THE RELATIONSHIP OF TEAM ENTHUSIASM TO THE FOUR STAGES OF GROUP DEVELOPMENT

Note that low enthusiasm characterizes the storm stage, but that every team eventually leaves that stage and enthusiasm increases. The length of time that each team spends at each stage can be highly variable.

To successfully include team members:

- The goals need to be clear and worthwhile.
- Recognition and support must come from the outside.
- Membership in the group should not interfere unduly in other aspects of the members' lives.
- The individual needs to feel that membership in the group will meet his or her needs.

The first task of the new group is orientation. The group must address issues openly and honestly. If there are significant problems, they must be addressed. Because there is so much going on to distract the members' attention during the form stage, the team accomplishes little, if anything, that concerns its project goals. This is perfectly normal.

Transition out of Stage 1 usually occurs after the majority of the members have made the unconscious decision to join the group and participate in its work.

There is general agreement that the goals are achievable and the group can work on the task. There also might be a false sense that the team is so able that they will be able to complete the project in a very short time.

Stage 2 : The Storm Stage

Once a group has successfully oriented itself, it needs to address the members' concerns about inclusion and control. Typically, this is a fairly stormy process and is probably the most difficult stage for the team. As members begin to realize the amount of work that lies ahead, it is normal for them to panic. They begin to realize that the task is different and more difficult than they had imagined. Some of the behaviors that occur during the storm stage are:

- conflict over leadership, authority, rules and the agenda
- interpersonal disagreement
- verbal and nonverbal resistance
- self-oriented behavior: dominating, withdrawing, blocking, recognition-seeking
- arguments, counter proposals
- frustration
- challenging of the roles and responsibilities
- criticizing team goals as being unrealistic

Transition out of Stage 2 usually occurs when there is group agreement on how the work will be done. There must also be a sense of having resolved personal concerns about control and effectiveness.

Stage 3 - The Norm Stage

While their concerns about inclusion and control have been resolved, the team members still need to address concerns about openness before they will be ready to enter enthusiastically into the team's work. The group's task at this stage is establishing open communication. The goal is for all members to feel they can speak openly and safely what is on their minds. The team needs to establish how they will insure that everyone's ideas are heard, differences are managed openly and constructively, and that decisions are being made with everyone's support.

Some feelings include:

- the ability to express criticism constructively
- the acceptance of membership in a team
- the belief that things will work out

Some behaviors include:

- attempts to achieve harmony by avoiding conflict
- friendliness, sharing
- a sense of team cohesion
- a common spirit and common goals
- the reestablishing of team boundaries (the norms)

Transition out of Stage 3 occurs when the team recognizes that decisions must be made jointly and that each member is free to speak his or her own mind. As team members begin to work out their differences, they will have more time and energy to spend on the project. At this stage they will begin to make significant progress.

Stage 4 - The Perform Stage

At this stage, members have developed genuine agreement on their tasks relating to orientation, organization, and communications. Relationships and expectations have been settled. The environment is non-threatening because members have worked through the issues of control and communication. Collaboration occurs and performance is optimized.

Some behaviors that occur during the perform stage are:

- ability to work through problems
- close attachment to the team
- trust
- honesty

The team is now an effective, cohesive unit. You can tell when your team has reached this stage because you start accomplishing a great deal. It is important to note that over the life of the team, concerns about inclusion, control and/or openness may arise again and again. **Teams can cycle through a stage more than once. Team members should be attentive to this cycling, and when necessary, stop and address the issues as they arise.**

The four stages of team development are predictable and natural. However, the time that any one particular team spends in any one stage is not predictable. The duration and intensity of the stages varies from team to team. Understanding the stages of growth will prevent team members from overreacting to normal problems and setting unrealistic expectations that add to frustration. With patience and effort an group of independent individuals will grow into an effective, functioning team.

Characteristics of a Successful Team

A team works best when all members:

- understand the team's purpose
- agree on the team's mission
- see the mission as feasible
- have a clear vision
- recognize the goals of the larger project and the purposes of individual steps

Individuals on successful teams have some basic needs:

- inclusion
- control
- openness
- high level of performance

Some fundamental ingredients for a successful team include:

- clarity in goals
- clearly defined roles
- clear communication
- ground rules
- operating procedures
- contracting
- team building

PART 2: ROLES

Quality Boards (QBs)

QBs choose quality improvement projects and appoint teams. QBs champion Quality Improvement Teams (QIT), by sponsoring them so that they can operate within the overall organizational parameters and by providing the resources they need to succeed.

Quality Advisors (QAs)

QAs are members of the Quality Board who understand the problem solving model and the basic tools included in this handbook. He or she will likely attend first several meetings in order to stay informed on the team's progress. QAs will meet frequently with the team leader, in order to accurately represent team progress to the Quality Board and Quality Council. QAs assist the team leader with team-related issues. The QA might also suggest ways to look at processes in order to assist team in finding their own solutions. He or she will also help the team communicate their findings and new ideas to management.

Team Leaders

Team leaders are normally selected by the Quality Board. A team leader generally has input into and control over group decisions equal to the rest of the team members. Team leaders have knowledge of the subject matter, so they have an active role in the determination of content. The team leader's responsibilities include logistics, serving as a guide through the problem-solving process, and delegating responsibility for logistics and other administrative chores. Other duties are planning meetings, setting agendas, and orchestrating minute-taking and distribution, modeling appropriate behavior, helping to establish and abiding by the ground rules and operating procedures, and keeping the group focused on the task at hand.

Facilitators

Facilitators are used because of their working knowledge of TQM principles and procedures, and their skills in group dynamics, meeting management and the tools in this handbook. Facilitators do not participate in subject matter discussions, or provide input into, or have control over content decisions. The facilitator's role is that of a consultant; knowing how the process works and how to keep team efforts focused. Because the facilitator is not responsible for the decisions, or content, of the group, he or she has observes and comments on the group process. **Specifically, the facilitator assists the team leader with meeting preparation (agenda development and meeting objectives). During the meeting, the facilitator checks for agreement among all team members, and helps the team summarize agreements and commitments made in the meeting, set new objectives, and evaluate their effectiveness as a team. The facilitator will also help team members keep their commitments, intervene when appropriate to correct problem behavior or dynamics, and will encourage team growth by providing feedback on the team's process. The facilitator does not evaluate group members' ideas or the validity of their decisions.**

Team Members

Teams are typically 5-8 people who are chosen by the QB and assigned a quality advisor from the QB. Team members are actively involved in the process or problem identified for improvement as customers, stakeholders, or process owners. Team members are subject matter experts and are responsible for the content of the process. They research specific problems, and implement and evaluate solutions with the approval and guidance of the QB. They share improvements and lessons learned with rest of organization. **Team member duties and responsibilities include consideration of team participation as priority job responsibility, which means attending all meetings, working cooperatively with other members of the team, helping to establish and abiding by the ground rules and operating procedures for the team, making presentations to the QB, sharing responsibility for logistics and administrative tasks of the team and, carrying out team assignments between meetings, complying with team deadlines, and, ultimately, implementing new improvement processes and procedures.** Other responsibilities might include recording and minute keeping:

> **Recorder:** The recorder is responsible for keeping a careful meeting record on a flipchart or whiteboard. This record assists members in focusing on the meeting. The team might decide to rotate this job among the team members. The recorder records team comments and

decisions, seeks clarification when necessary, verifies written phrases with the speaker, writes legibly, and recognizes that the "power of the pen" should not be abused. This recorder duties are often performed by the Facilitator.

Minute Keeper: The minute keeper prepares a permanent record of the team's progress. This task might also be a rotational duty shared by all members of the team. The duties are to prepare the minutes from the meeting and ensure that the minutes are reviewed and distributed as outlined in the operating procedures.

SECTION IV: COMMUNICATION

Communication among team members, as well as with the sponsoring Quality Board and Quality Council, is essential to a successful quality improvement project. Since team relationships have been covered in Section III, the focus of the following material is on presentations to management.

ONGOING PROGRESS REPORTS

You should keep your Quality Advisor (sponsor) informed of your progress at every stage of your quality improvement work. Ideally, your QA will take an active interest in your progress, but you must be prepared to take the intiative to brief her or him if necessary. Such briefing may be either informal or formal; that decision is up to the team and the QA. Some suggestions to make the briefing process go smoothly include:

- ✓ store copies of your team's minutes in a loose-leaf binder for reference at every meeting and when briefing your advisor; assign the responsibility for this binder to one person
- ✓ include a section in the binder that is devoted to neat drawings of all of the graphs and charts that you might generate
- ✓ devote another section of the binder to data gathering; summarize the results as clearly and concisely as possible
- ✓ hold "mini-briefings" between one or two team members and the QA to discuss the considerations at each step of the process (see Section VI, Step-By-Step); these meetings might take place within a week of every team meeting
- ✓ plan to hold your information-sharing sessions just before the Quality Board meets so that the QA may report on your progress

FORMAL REPORTING TO THE QUALITY BOARD OR QUALITY COUNCIL

The need to make a formal team presentation to management might arise several times, and for different reasons, during your process improvement project. The following presentation steps will help you to present an effective report.

1. ***Determine the purpose of your presentation.*** Why are you meeting with management? Is your presentation intended to be informational or persuasive? Some reasons might include:

- to obtain understanding, support, approval or commitment
- to show management what you are doing
- to keep management informed of actions you have taken
- to allow the team to receive recognition for their work
- to ask for a decision if you are at a critical point

2. ***Define the objective of your presentation.*** What is your desired outcome? How do you want management to react?

3. ***Know your audience.*** Think about your audience and how they might react to your presentation:

   - What are their attitudes toward the subject?
   - Do they have special skills or knowledge that will make a difference in your presentation style or depth?
   - What is their relationship with the team and with individual team members?
   - Are they able to act on your recommendations?
   - Do they like lots of data or a general summary?

4. ***Outline your main ideas and steps.*** Organize your thoughts for presentation in a logical manner. Under each main topic, identify what the audience needs to understand, and be sure that you know the arguments that support your objectives. When you talk about causes and solutions, use any facts, figures, and graphical aids you have generated to support your discussion.

5. ***Assign each member a role.*** This is an important concept, since it will:

   - reinforce each member's sense of ownership
   - allow the recognition to be shared
   - allow the responsibilities to be shared
   - emphasize to the audience that it is a team effort

   In order to involve everyone, you may break the presentation into sections, have two members share one step, and have another member introduce the team. The

facilitator will usually attend the presentation, but will not participate in it.

6. ***Write a final outline.*** You can divide the presentation into the following steps:

   a) team member introduction (if necessary)

   b) statement of objectives

   c) explanation of the problem

   d) explanation of the problem-solving process and your techniques

   e) presentation of the results and the proposed solution

   f) summary

   g) recognition of those who assisted

   h) questions and answers

   Assign an estimated time to each part of the presentation, and prepare text as necessary. Consider what kind of handouts might be useful, and whether the audience should receive them beforehand.

7. ***Determine what visual aids might be appropriate.*** Some of the benefits include:

   - clarification of explanations
   - emphasis where needed
   - continuity
   - evidence of the process
   - memory aids for presenters

8. ***Think about the room and the arrangement:***

   - How many people will attend the meeting?
   - Will the audience be distracted by anything inside or outside of the room?
   - Do you want a lot of discussion during the presentation or to lead it in a more formal way?

9. ***Practice the presentation.*** Practicing will help you to identify potential problem areas and to be more confident. Try to anticipate the questions that the audience might ask you, and how you might answer them. As a team, practice also helps you to coordinate the logistics of different speakers and the use of visual aids. **Your QA should be enlisted as a dress rehersal audience.** He or she can help the group avoid the pitfall of being unable to respond to difficult questions.

V: 8 STEP PROBLEM SOLVING MODEL

SECTION V: THE EIGHT STEP PROBLEM-SOLVING MODEL FOR CONTINUOUS IMPROVEMENT

STEP 1: IDENTIFY THE PROBLEM

STEP 2: SELECT THE PROBLEM

STEP 3: ANALYZE ROOT CAUSES

STEP 4: IDENTIFY SOLUTIONS

STEP 5: SELECT A SOLUTION

STEP 6: TEST THE SOLUTION

STEP 7: IMPLEMENT THE SOLUTION

STEP 8: TRACK EFFECTIVENESS

VI: STEP-BY-STEP

SECTION VI: STEP BY STEP

STEP 1: IDENTIFY THE PROBLEM

The opportunity for continuous improvement is in all that we do!

The purpose of this step is to identify problems within a work system. It is important to distinguish *reality* from the way things are described in policies and procedures. Performance measurements are necessary to ensure that baseline data are available. It is also important to understand internal and external customer and supplier relationships.

Parts of Steps 1 and 2 might be completed by the Quality Board or Council sponsoring the team. It is especially important for the team to spend some time with its advisor early in the problem-solving process to ensure that all team members of the team understand the scope of the project.

A. Study and document existing systems and processes.

Considerations:

- Why are the processes necessary? Do they add value? Can they be eliminated? Streamlined?
- How do the processes relate to organizational goals? To the future?
- Are the processes documented? Do they reflect reality?
- What are others doing? (Benchmarking)

B. Identify the relationships, interests, and needs of customers, suppliers, and workers involved in the process.

Considerations:

- Who are the stakeholders? The process owners?
- Who are the suppliers? The customers? Have the customers been involved?
- What obstacles exist? Are there any voids?
- What are the customer's requirements and expectations? Are they being met?
- Have the customer's requirements and expectations been defined and communicated to suppliers? Are they valid? Are they being met?

C. Study existing measurements to ensure that they are reliable.

Considerations:

- What measurements exist? Are they reliable?
- What do they really measure? What do they indicate?
- Can the systems or processes be measured more effectively?
- If measurements do not exist, how can they be measured?

D. Evaluate your problem-solving project and establish parameters, including a timetable, estimates of needed resources and costs, and guidelines.

Considerations:

- When should the project begin? When should it be completed? Why? Are there any other factors to be considered?
- Is a team required? If so, what kind of team?

- How much time will be needed for each phase of the project from team formation through evaluation?

- Who should be involved? How should they charge their time?

- How will the activity be monitored and tracked?

- Are there problems beyond the scope of the team that should be referred to the Quality Board or Council?

STEP ONE OUTCOMES

A team of the best people for the project is identified and involved.

All members of the team have a common understanding of the process flow.

Performance measures or methods to collect reliable data about the process have been identified.

STEP ONE TOOLS

- ✓ Brainstorming
- ✓ Data Gathering
- ✓ Flow Charts
- ✓ Meeting Management Tools
- ✓ Pareto Charts
- ✓ Project Mission Statement
- ✓ Questionnaires and Surveys
- ✓ SIPOC Analysis

THE TEAM IS READY TO PROCEED TO STEP 2 WHEN:

1. It has adequately addressed all appropriate considerations with the Quality Advisor, sponsoring Quality Board or the Quality Council

2. It has achieved the Step One outcomes

STEP 2: SELECT THE PROBLEM

Focus on the areas of greatest opportunity and highest priority.

The purpose of this step is to prioritize problems and select the one improvement opportunity on which the team will focus.

As with Step 1, the sponsoring Quality Board or Council might complete all or part of Step 2.

A. List and prioritize problems within the work system.

Considerations:

- Is someone else working on this problem?
- Is the problem chronic?
- Is it a system problem, or a management/policy issue?
- Is the effect of the problem measurable?

B. Measure and analyze prioritized problems (see Section VII: Tools for details).

C. Select the problem that offers the highest payoff for the organization.

Considerations:

- What do you want to achieve? What results do you anticipate?

- How will the results affect the organization?
- Who will be affected? How will it benefit them?
- What is the likelihood of success?
- Have you calculated the cost of poor quality?

D. Write a description of the team's problem.

Considerations:

- What is the effect of the problem on customers and other stakeholders?
- Is the description of the problem specific?
- Can the effect of the problem be measured?
- Have you identified the "pain"?

E. Write a mission statement that establishes an imperative for action: to create a new system or process, to improve an existing system or process, or to solve a problem that ensures an orderly and logical approach to analyzing and refining work processes.

Considerations:

- What is the process or problem to be studied?
- Is the team being asked to improve an existing process, plan a new process, or solve a problem?
- Does the project involve an entire process or only part of a larger process?
- What limitations exist, including limits on time and money?
- What magnitude of improvements is the team expected to make?
- Are management's expectations of the team clear?
- Does the team have the concurrence of the Quality Board, and Quality Council? Has the Quality Coordinator been involved?

- What authority does the team have for such tasks as calling in coworkers or experts to request normally inaccessible information?

- When is the project scheduled to begin? If appropriate, what is the target completion date?

- Are your goals realistic?

- Is the project important to the overall goals of the organization?

STEP TWO OUTCOMES

An imperative for action is established with a team charter and mission statement that explains goals, benefits, and other key considerations.

A project that will add value to the organization is selected.

An improvement goal is identified.

STEP TWO TOOLS

- ✓ Affinity Diagrams
- ✓ Brainstorming
- ✓ Control Charts
- ✓ Data Gathering
- ✓ Decision Matrix
- ✓ Flow Charts
- ✓ Force Field Analysis
- ✓ Histograms
- ✓ Meeting Management Tools
- ✓ Pareto Charts
- ✓ Prioritization of Problems
- ✓ Project Mission Statements
- ✓ Questionnaires and Surveys
- ✓ SIPOC Model
- ✓ Work Flow Diagrams

THE TEAM IS READY TO PROCEED TO STEP 3 WHEN:

1. It has adequately addressed all appropriate considerations with the Quality Advisor, sponsoring Quality Board or the Quality Council

2. It has achieved the Step Two outcomes

STEP 3: ANALYZE ROOT CAUSES

We must treat the problem rather than its symptoms!

The purpose of Step 3 is to identify why the problem is occurring. The root cause is the key contributor to the problem. In some cases, the root cause consists of several smaller causes. Your task is to diagnose the "vital few" rather than the "trivial many" causes of the problem.

A. Identify and prioritize root cause theories.

Considerations:

- What are all the possible causes for the problem?
- What are the "causes of the causes" on your list?
- Have you considered all aspects of the issues and the environment?

B. Measure and analyze prioritized list.

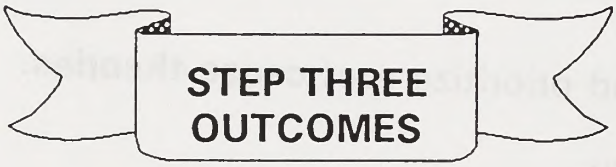
Considerations:

- Can you see patterns in your data?
- Are your data reliable and relevant to the predicted cause?
- Does the problem *always* appear when *any* of the identified possible causes are present?
- Are data or information biased? How can you eliminate this bias?

C. Select primary root causes.

Considerations:

- What data did you use? How were they collected? Are they reliable?
- Is the identified cause systemic?
- How did you verify the cause?
- Do people with knowledge of the process agree that you have identified a cause?
- Does it cause a significant portion of the problem?
- Are other processes affected? If so, how?
- What action should you take?



Collected data about the process are reviewed.

Charts and graphs of data, to aid in analysis and decision-making, are prepared.

Root causes of the problem are identified and verified.

STEP THREE TOOLS

- ✓ Affinity Diagrams
- ✓ Brainstorming
- ✓ Cause and Effect Diagrams
- ✓ Control Charts
- ✓ Data Gathering
- ✓ Dot Plots
- ✓ Flow Charts
- ✓ Histograms
- ✓ Meeting Management Tools
- ✓ Pareto Charts
- ✓ Questionnaires and Surveys
- ✓ Run Charts
- ✓ Scatter Diagrams
- ✓ Time Order Plots
- ✓ Work Flow Diagrams

THE TEAM IS READY TO PROCEED TO STEP 4 WHEN:

1. It has adequately addressed all appropriate considerations with the Quality Advisor, sponsoring Quality Board or the Quality Council

2. It has achieved the Step Three outcomes

STEP 4: IDENTIFY SOLUTIONS

There is a variety of ways to capture any opportunity

Once issues and processes have been well-defined and studied, and you have identified opportunities, it is time to generate options, ideas, and alternatives. The purpose of Step 4 is to determine potential solutions that will eliminate the root causes of the problem.

A. Review existing systems and processes, as well as data and information.

Considerations:

- Have the existing processes been documented? (Steps 1 and 2)
- What data and information are available? (Steps 2 and 3)
- Are customer requirements and expectations being met?
- Are suppliers meeting requirements and expectations?
- What are others doing? (Benchmarking)
- What technology is available? (Benchmarking)

B. Obtain input from customers, processors, and suppliers.

Considerations:

- What methods will be used? Are they appropriate?
- Is training required? What materials and equipment are needed?

- Who should be involved, in addition to the team?

- How will these people be briefed in advance? By whom?

C. Generate options, ideas, solutions, and alternatives. Make quantity, rather than quality, your objective. Discourage negative thinking and encourage fun. Pretend that there are no rules or limitations. Play games of "what if."

Considerations:

- What if no change occurs? How can you improve the process?

- Can problems be solved? What can be eliminated? Changed?

- What can be streamlined? Added? How can positives be enhanced?

- Can negatives be eliminated? What can be combined?

- Are there some obvious simple solutions that can be implemented immediately? Who has the authority to implement them? Is further analysis required first? Do obvious solutions result in process tampering?

STEP FOUR OUTCOMES

The team has generated a list of potential solutions to eliminate root causes of the problem.

Obvious solutions are implemented, where appropriate.

STEP FOUR TOOLS

- ✓ Cause and Effect Diagrams
- ✓ Control Charts
- ✓ Data Gathering
- ✓ Dot Plots
- ✓ Flow Charts
- ✓ Force Field Analyses
- ✓ Histograms
- ✓ Meeting Management Tools
- ✓ Pareto Charts
- ✓ Questionnaires and Surveys
- ✓ Run Charts
- ✓ Scatter Diagrams
- ✓ Time Order Plots
- ✓ Work Flow Diagrams

THE TEAM IS READY TO PROCEED TO STEP 5 WHEN:

1. It has adequately addressed all appropriate considerations with the Quality Advisor, sponsoring Quality Board or the Quality Council

2. It has achieved the Step Four outcomes

STEP 5: SELECT A SOLUTION

The goal of continuous improvement is to develop a solution with data collected after a systematic study of causes.

The purpose of Step 5 is to select the best solutions for addressing the root causes of the process problem. If you are working on simple process improvement, this step will help you to determine the best choices for change.

A. Review the goals and boundary conditions in the your mission statement.

Considerations:

- Are the goals and boundary conditions still valid?
- What can be changed? Is the mission statement flexible?
- Are there any additional limitations? Hidden agendas?

B. Review the list of possible solutions and compare them with goals to prioritize the list.

Considerations:

- Which options compare most favorably?
- Which options, ideas, solutions, etc. can be combined?
- What are the top four options?

- What are the advantages?

- What are the disadvantages? Is there consensus on the team? What obstacles exist?

C. Critically analyze the top solutions and select the best.

Considerations:

- What are the costs involved for the top few options?

- What are the ongoing costs? The implementation costs?

- Are there hidden costs? What do you receive in return?

- Are the resources available? Is the appropriate technology available?

- How long will it take to implement?

- How do your solutions compare with what others are doing?

- What are the future implications? What will the future environment be?

- How will your solutions affect other processes? Will the solution solve a problem in one area, only to cause a problem in another?

- Do your solutions fit in with the way business is done?

- Do your solutions fit in with the organizational culture? Who will be affected?

- Have all the stakeholders and customers been involved or considered?

- Have all the process owners and suppliers been involved or considered? Is there consensus?

- What are the benefits? For whom? What are the obstacles?

- How do the benefits compare with the original goals?

- How do the benefits fit in with organizational goals and objectives?

- Who will make the final decision? What will need to happen?

- Does it really address a root cause and not a symptom?

D. Evaluate each of the top solutions to determine if it can and should be tested.

Considerations:

- Will the solution affect multiple functions or a large employee base?
- If so, could it be tested in just one function, or on a small group of employees?
- Is the solution very simple in nature, or very complex? (If it is simple, a test might not be necessary.)
- Is testing the solution cost effective?
- What are the risks and associated costs if the solution is not effective?

STEP FIVE OUTCOMES

The team has selected a solution that will eliminate all or a major portion of the most significant root cause or causes of the problem, or is the best choice for process improvement.

The team has considered the impact of the solution on all the stakeholders.

The team has considered the costs to test and to implement the solution.

STEP FIVE TOOLS

- ✓ Action Plans
- ✓ Control Charts
- ✓ Decision Matrices
- ✓ Force Field Analyses
- ✓ Histograms
- ✓ Meeting Management Tools
- ✓ Mistake Proofing
- ✓ Pareto Charts
- ✓ Prioritization of Problems
- ✓ Project Mission Statements
- ✓ Scatter Diagrams

THE TEAM IS READY TO PROCEED TO STEP 6 WHEN:

1. It has adequately addressed all appropriate considerations with the Quality Advisor, sponsoring Quality Board or the Quality Council

2. It has achieved the Step Five outcomes

STEP 6: TEST THE SOLUTION

Before releasing your solution to others to use, consider the impact of the change!

The purpose of Step 6 is to determine if a test of the proposed solution or improvement is necessary and to carry out the test. As with all of the other steps, careful planning is required if the improvement is to be successful.

A. Identify the test conditions.

Considerations:

- What needs to happen? What is the most effective and efficient plan of action?
- Who needs to be involved? Are they committed?
- What resources will be needed? How should time be charged? What is the budget for the test?
- What are the present and future implications of the change?
- Are other processes affected?
- Are there other events with which the test could be coordinated?
- What part of the organization should be tested?
- How large should the test population be?

- Is the test population representative of the whole or might the results be biased?

- What obstacles are present? How can they be minimized or eliminated?

B. Prepare an action plan. Many of the considerations will already have been identified in the previous step, and should be addressed in the plan.

Considerations:

- What is the action or activity?

- Who is responsible for each action or activity?

- What are the time frames for completion?

- What is the estimated cost?

- Who will be impacted?

C. Brief the affected personnel on the changes in the system.

Considerations:

- Is approval required for the team to test its solution?

- Does some level of management approve the test?

- Which parts of the organization should be involved?

- Which employees will be carrying out the revised work process or procedure?

- How will these employees be involved?

- Do they require training? Who can brief or train the involved employees?

- Who else might be impacted by the change? Should suppliers or customers be included?

D. Implement the test action plan and measure the results.

Considerations:

- How are you documenting the test? What communication mechanisms are in place?
- What follow-up evaluation activities are required? Have you planned them?

E. Analyze the results and make necessary revisions to the action plan.

Considerations:

- Is the solution eliminating the significant root causes?
- Have other problems emerged?
- Was the test performed as planned?
- Are the test results reliable?
- Is an additional test recommended?
- Are there better ways to conduct the test?
- What changes should be made to the test action plan? To the testing procedures?
- What conditions have changed?

STEP SIX OUTCOMES

The selected solution is tested as appropriate with a detailed plan to collect relevant data.

The results of the test are used to make the relevant changes to the action plan.

STEP SIX TOOLS

- ✓ Action Plans
- ✓ Control Charts
- ✓ Histograms
- ✓ Meeting Management Tools
- ✓ Pareto Charts
- ✓ Questionnaires and Surveys
- ✓ Scatter Diagrams
- ✓ Surveys
- ✓ Testing the Proposed Solution

THE TEAM IS READY TO PROCEED TO STEP 7 WHEN:

1. It has adequately addressed all appropriate considerations with the Quality Advisor, sponsoring Quality Board or the Quality Council

2. It has achieved the Step Six outcomes

STEP 7: IMPLEMENT THE SOLUTION

Success equals full implementation of the solution throughout the organization you are serving.

Full implementation of the solutions involves the execution, ongoing measurement and monitoring of the improvement, solution, or new process. The performance measurements that are used should be as consistent with previous measurements as possible.

A. Identify the conditions for full implementation.

Considerations:

- What changes are necessary when moving from the smaller test to a large full scale implementation?
- Who else should be briefed?
- What employee training is required?
- Are reliable performance measures in place?

B. Prepare the action plan. Many of the considerations will already have been identified in the previous *test* action plan and should be addressed in the final plan.

Considerations:

- What is the action or activity?
- Who is responsible for each action or activity?
- What are the time frames for completion?
- What is the estimated cost?
- Who will be impacted?
- What changes have you made as a result of the test?

C. Present your recommendations. Review Section IV: Communication in this handbook.

Considerations:

- How will you brief the sponsoring Quality Board or Council?
- Did you fully utilize your Quality Advisor?
- Who else should be briefed for approval and for buy-in?
- Are you prepared to receive guidance and make modifications to your solution based on feedback?
- Do you have data to support each aspect of your recommendation?
- How do you want to receive feedback from your sponsors and decision-makers?
- Can you summarize the recommendations?

D. Implement and monitor the decisions.

Considerations:

- Are the new solutions working? Has everyone "bought in"?'
- Are adjustments required? What obstacles exist?
- Has improvement been realized? Is there a payback?
- Are the performance measurements appropriate?

- How are stakeholders reacting and adjusting to the change?

- Does the documentation reflect what is happening? Is cross-referencing with other documentation required? Is your documentation simple, straightforward, and easy to understand? Have all the obstacles been addressed?

STEP SEVEN OUTCOMES

A plan for full-scale implementation has been designed.

Performance measures to evaluate the effectiveness of the solution are in place.

Approval to implement the plan has been granted.

All affected parties, stakeholders, customers, suppliers, and workers in the process understand the solution and how to support the improvement.

STEP SEVEN TOOLS

✓ Action Plans
✓ Flow Charts
✓ Meeting Management Tools
✓ Project Mission Statements
✓ Questionnaires and Surveys

THE TEAM IS READY TO PROCEED TO STEP 8 WHEN:

1. It has adequately addressed all appropriate considerations with the Quality Advisor, sponsoring Quality Board or the Quality Council

2. It has achieved the Step Seven outcomes

STEP 8: TRACK EFFECTIVENESS

In a changing world, today's solution might not fit tomorrow's environment!

The purpose of Step 8 is to ensure that systems are in place to measure the extent to which the improvement objectives were met, to set the stage for continuous improvement, and to ensure that gains are not eroded or lost. In addition, the team should monitor their own effectiveness and document lessons they learned. *Success is the degree to which the solutions in fact eliminate the root cause of the problem when tracked over time.*

A. Assign tracking responsibility. Formal tracking of the process should be a continuing part of the action plan to assure that gains and improvements are not only verified, but are also maintained. As other changes are implemented in other parts of the system, the information collected through formal tracking must be monitored to ensure that the gains are not sacrificed for other "improvements".

Considerations:

- How is the change monitored and reviewed? By whom?
- Is the new process working? Can it be improved?
- What follow-up evaluation and activities are required? Have they been planned?

B. Measure and analyze the improved system. ***The bottom line for the process action team is to verify that the implemented change is, in fact, an improvement.***

Considerations:

- Is it a better process following the change than it was before the change, and do we know how much of an improvement the change represents?
- Is there new information that should be collected?
- Can the team document the quality of their decision?

C. Evaluate the team's effectiveness and officially acknowledge it. It is important not to overlook anyone when planning recognition. It is better to err on the side of awarding too many people than not enough people. It is also important to tie the recognition to the benefits realized from the change.

Considerations:

- What was the total investment in the project?
- How effective was the team? What were the problems?
- How were the problems overcome? What were the lessons learned?
- Who, in addition to the team members, was involved?
- How can the team and other contributors be recognized and rewarded appropriately?

D. Plan for continuous improvement.

Considerations:

- Has any part of the implementation not occurred?
- Is there any unfinished business? Do you have any new insights?
- What valid options or ideas were not implemented?
- Are the process owners aware of the ideas that were not implemented? Are they committed to continuous improvement?

- How have you planned for continuous improvement? When will it occur? Who will oversee it?

- How will this improvement be monitored over time? When will it occur? Who will oversee it?

STEP EIGHT OUTCOMES

The solution is implemented throughout the organization.

Lessons learned by the team are documented.

The team's efforts have been recognized and celebrated.

There is a plan in place to monitor the solution over time in order to secure the benefit and to plan for continuous improvement.

STEP EIGHT TOOLS

- ✓ Action Plans
- ✓ Control Charts
- ✓ Data Gathering
- ✓ Dot Plots
- ✓ Flow Charts
- ✓ Histograms
- ✓ Pareto Charts
- ✓ Scatter Diagrams
- ✓ Questionnaires and Surveys
- ✓ Run Charts
- ✓ Time Order Plots
- ✓ Work Flow Diagrams

THE TEAM IS READY TO PROCEED WHEN:

1. It has adequately addressed all appropriate considerations with the Quality Advisor, sponsoring Quality Board or the Quality Council

2. It has achieved the Step Eight outcomes

VII: TOOLS

SECTION VII: TOOLS

HOW TO USE THE TOOLS FOR MEASUREMENT OF QUALITY IMPROVEMENT

The key to successful quality management is measurable improvement. If you can show tangible improvement as a result of the changes in your process, you will be able to demonstrate their worth and celebrate your successes. Measurement is the best way to confirm change. It is useful for documenting the status quo as well as helping you to determine whether you are on the right track. The use of TQM-related measurement principles and tools is also essential to establishing a team's credibility.

DEVELOPING A MEASUREMENT SYSTEM

1. ***Define what you want to improve and measure.*** The specificity is up to you. Some examples of what to measure include: the ultimate success with the customer, the performance of the product or service and the "upstream" (suppliers) and/or process elements.

You may use a matrix like the one below.

2. ***Decide how to express the item in numeric units.*** More than one type of numeric unit might be appropriate, but it is best to select something over which you have control. It is also important to consider the potentially adverse effects of a change, and devise a way to monitor them, even if they are not currently a problem.

3. ***Define a reference for your numeric units.*** Specify exactly what you mean by the numeric units you selected, e.g., does "days" mean working days or calendar days?

4. ***Determine a data source.***

NUMERIC UNITS	REFERENCE	DATA SOURCE
Total time to provide service	number of working hours from check-in to check-out	Data log
How long to do paperwork	number of working hours from check-in until paperwork is satisfactorily completed	?
Number of errors	how many times it needs to be redone	Data log

HOW TO USE MEASUREMENT TO CHART QUALITY IMPROVEMENT

1. ***Establish the measurement system.*** See the instructions on the previous page.

2. ***Determine the baseline.*** Control charts and time order graphs are especially appropriate to this step.

   a. Gather historical data (where have we been?).

   b. Determine the status quo (where are we now?).

   c. Identify the variation in the system, if possible.

   d. If you have no historical data, determine how else you might establish a baseline.

3. ***Set targets for improvement:***

   a. Base your assessment on what might be possible.

   b. Think about the best conceivable outcome, and determine the gap between the present and that goal.

   c. Develop short-range targets, which should be:

      1. ...a measurable improvement of any magnitude as long as it is long-lasting.

      2. ...based on a change to the system (vs. a one-time event).

      3. ...to exceed the historic "best ever" performance for a sustained period of time.

   d. Long-range targets should be tied to the organizational vision. These targets are the ultimate goal, which might never be achieved.

4. ***Document the following improvements:***

   a. the changes to the system that were made

   b. the measurable gain

5. ***Celebrate the achievement of each short-term goal.***

6. ***Track performance over time, and set new targets.***

MATRIX OF TOOLS AND STEPS

TOOLS	PROBLEM-SOLVING MODEL STEPS							
	1	2	3	4	5	6	7	8
ACTION PLANS					✓	✓	✓	✓
AFFINITY DIAGRAMS		✓	✓					
BRAINSTORMING	✓	✓	✓					
CAUSE AND EFFECT DIAGRAMS			✓	✓				
CONTROL CHARTS		✓	✓	✓	✓	✓		✓
DATA GATHERING	✓	✓	✓	✓				✓
DECISION MATRIX		✓			✓			
DOT PLOTS			✓	✓				✓
FLOW CHARTS	✓	✓	✓	✓			✓	✓
FORCE FIELD ANALYSIS		✓		✓	✓			
HISTOGRAMS		✓	✓	✓	✓	✓		✓
MEETING MANAGEMENT TOOLS	✓	✓	✓	✓	✓	✓	✓	✓
MISTAKE-PROOFING					✓			
PARETO CHARTS	✓	✓	✓	✓	✓	✓		✓
PRIORITIZATION OF PROBLEMS		✓			✓			
PROJECT MISSION STATEMENT	✓	✓			✓		✓	
QUESTIONNAIRES AND SURVEYS	✓	✓	✓	✓		✓	✓	✓
RUN CHARTS			✓	✓				✓
SCATTER DIAGRAMS			✓	✓	✓	✓		✓
SIPOC MODEL	✓	✓						
TESTING PROPOSED SOLUTION						✓		
TIME ORDER PLOTS			✓	✓				✓
WORK FLOW DIAGRAMS		✓	✓	✓				✓

ACTION PLAN

PURPOSE

To develop and document a plan for implementation of the proposed solution.

PROCEDURES

1. ***Visualize how the proposed solution will work.***

2. ***Determine the changes necessary for a full-scale implementation of the proposed solution.*** These might be in the categories of:

   a. Methods and procedures
   b. Additional training
   c. Increased or redistributed funding
   d. Equipment
   e. Personnel

3. ***Develop a timetable for implementation and assign responsibility for tasks.***

4. ***Present the implementation plan to management.*** See Section IV: Communication above.

5. ***Monitor the implementation.***

FOR MORE HELP WITH ACTION PLANS:

Use the Action Plan worksheet in Appendix I.

See your TQM coordinator.

TIPS

▹ Maintain neat and organized records of the entire process

▹ Be certain to be thorough in task definition and assignment

ACTION PLAN WORKSHEET

HOW WILL THE NEW SYSTEM WORK?

When a fax comes into the office, the receptionist will call or leave a message for the addressee. The addressee will pick up the fax and route it to the people who need to see it.

WHAT CHANGES WILL BE NECESSARY?

A. METHODS AND PROCEDURES

1. Faxes will bypass the regular mail system.
2. Addressees will be notified as soon as the fax arrives.

B. ADDITIONAL TRAINING

None.

C. INCREASED OR REDISTRIBUTED FUNDING

None.

D. EQUIPMENT

None

E. PERSONNEL

Only the receptionist and the addressee will be involved, unless the addressee feels the need to involve others.

TIMETABLE AND ASSIGNMENTS

TASK	PERSON RESPONSIBLE	DEADLINE
Draft memo informing employees of new process	Quality Improvement Team leader	Within one week
Have memo signed by management and route to employees	Quality Improvement Team leader	Within two weeks

AFFINITY DIAGRAMS

PURPOSE

Affinity diagrams allow you to organize many ideas into logical groups.

PROCEDURES

1. ***Post several pieces of flipchart paper and supply each team member with a pad of "Post-it Notes" and a marker.***

2. ***Define your problem statement.*** Try to be more specific than broad, and write the problem in the form of a question, e.g., "what are the problems with the EA process?".

3. ***Each team member then silently writes their ideas, one per "Post-it Note", and places them, at random, on the flip chart paper.***

4. ***Arrange the ideas into logical groups.*** Each team member can place the notes into reasonable groups. If there are disagreements, duplicates may be written, or "loner" categories formed.

5. ***Develop headers.*** Write these headers on "Post-it Notes" and place them above the categories.

6. ***If possible, group the categories.*** These may be assembled under "super-headers", and your diagram is complete.

FOR MORE HELP WITH AFFINITY DIAGRAMS:

See the TQM coordinator.

TIPS

▹ Affinity diagrams are an excellent tool for the generation of energy and for team-building.

▹ Be sure to make a permanent copy of your diagram before you throw away the flipchart pages.

AGENDAS

PURPOSE

Agenda planning is the process of developing a detailed flow of topics, process steps, and the time necessary to accomplish the desired outcomes of a meeting.

PROCEDURES

1. ***Define your desired outcome.*** Begin by thinking about the goals and objectives for having the meeting. How does this meeting relate to the last and to the next meeting?

2. ***Consider each agenda item.*** Review the list of topics that must be covered to reach the desired outcome. Place the items in order.

3. ***Select your meeting methods.*** Identify the process steps by noting how each topic will be handled (e.g. present, review, small group discussion, brainstorming, list, evaluate), noting who the lead person is.

4. ***Determine the time necessary for each agenda item.*** Indicate the amount of time required for each item, including time for discussion that might follow. Can you comfortably cover the number of items you are proposing in the time you have available? Do you need to lengthen the meeting? Keep track of the actual times so you can get good at predicting how long your meetings will last in the future. If you think you will not have enough time to finish all items, indicate which are "musts" for this meeting. If the meeting is longer than 75 minutes, schedule a break.

5. ***Think about resources and materials you might need.*** Identify the appropriate room arrangements and materials needed (e.g. flip charts, markers, scratch paper, pens, overhead projector, screen)

6. ***Include a follow-up list.*** Include a column to indicate any follow-up for each item. If no follow-up is necessary, write in the word "none".

6. ***Include an assignment list.*** The individuals who are responsible for any follow-up actions should be listed with deadlines.

7. ***Consider Murphy's Law.*** Identify potential pitfalls and the appropriate preventions and/or interventions to deal with them. Throughout the agenda planning process, visualize the meeting and what it would take to make it work. About halfway through the agenda, plan an agenda checkpoint, so modifications can be made if necessary.

8. ***Plan ahead.*** Agenda items with follow-up actions, assignments, discussion topics are the start for building the next meeting's agenda. Don't forget to set a date for the next meeting.

9. ***Include an assessment agenda item.*** Plan time to evaluate how well the meeting went. Encourage participation from all members of the team. How was the pace, flow, and tone of the meeting? What didn't we like? Did we handle items in a reasonable sequence? How well did we respond to each other's questions? How satisfied are we with answers to our questions? Any other comments, observations, recommendations?

FOR MORE HELP WITH AGENDAS:

The Team Handbook, see the numerous listings in the index under "agendas".

How to Make Meetings Work, p. 201-211.

TIPS

▹ If possible, send out a computer message or hard copy of the agenda before the meeting, so the participants know what to expect.

▹ Remember that the team can consciously choose to change the agenda as the meeting progresses.

BRAINSTORMING

PURPOSE

To generate new ideas.

PROCEDURES

1. ***At the beginning of the meeting, list the ground rules, using markers on flipchart paper, and post them.*** You may need to remind yourself of them often. The rules include:

   - ★ No evaluation or criticism
   - ★ Every idea is written on the flipchart
   - ★ No idea is wrong or stupid
   - ★ Participants speak one at a time

2. ***After you have listed the ground rules, determine your topic, and be as specific as possible.*** Write this on flipchart paper and post it next to the ground rules.

3. ***You may conduct the session informally, with people simply calling out their ideas randomly, or formally, by going around the room and asking each person to contribute or pass.***

4. ***The second half of the meeting can involve evaluation and prioritization of the accumulated ideas, or a subsection of the team can do it later.*** Tools to help you with this step include: Decision matrices and prioritization of problems.

FOR MORE HELP WITH BRAINSTORMING:

The Team Handbook, pp. 2-37 - 2-39.

How to Make Meetings Work, p. 231

TIPS

- ▹ Keep the brainstorming session short (5-15 minutes)
- ▹ Write people's exact words to avoid misinterpretation or inadvertent evaluation

CAUSE AND EFFECT DIAGRAM

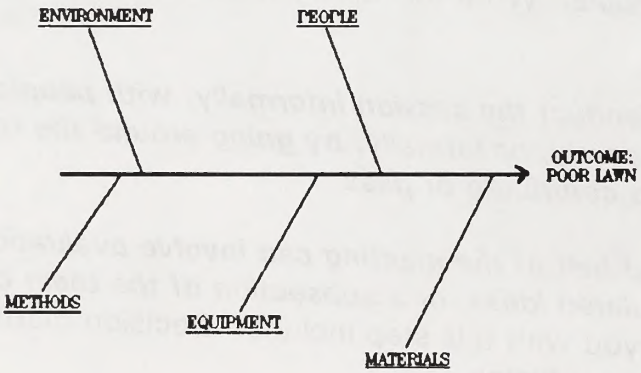
PURPOSE:

To illustrate the possible causes of problems. Cause and effect diagrams are also known as "fishbone" or "Ishikawa" diagrams.

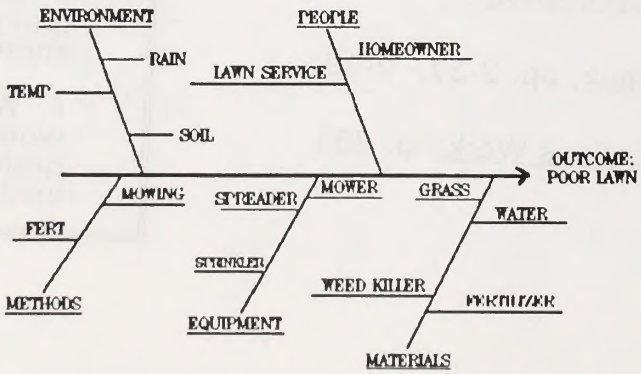
PROCEDURES

1. ***Decide on an outcome and place it at the end of a long arrow.*** This is the "spine":

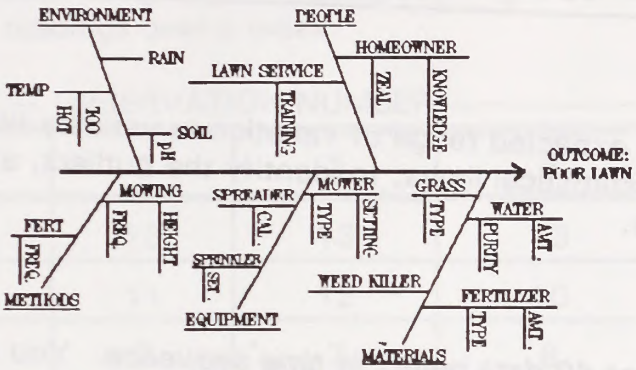
2. ***Select major categories and place them at the ends of diagonal lines ("ribs") that originate at the "spine".*** The categories are often the ones in the diagram, or they might be your own:



3. ***Decide which factors are important in each of the major categories and array them as "bones" originating at the "ribs".*** Try to select only the most broad categories:



4. ***Factors may be further broken down into variables, which are arrayed as "smaller bones" off of the "bones".*** The factors might have only one or more than one variable.



FOR MORE HELP WITH CAUSE AND EFFECT DIAGRAMS:

The Team Handbook, pp. 2-26 - 2-27

The Memory Jogger, pp. 24-29

TIPS

- Use as few words as you can
- Limit input to the team's scope of knowledge
- Achieve consensus on the description of the problem.

CONTROL CHART: VARIABLE DATA, MEAN AND RANGE CHARTS

PURPOSE:

To determine the expected range of variation in variable (vs. attribute) data over time within statistical limits, to identify the outliers, and to gauge change over time.

PROCEDURES:

1. ***Collect at least 40 data points in time sequence.*** You must collect them in *sets* of two or more and average them, so you have at least 20. These sets are called subgroups. A subgroup might consist of the average of two different readings over a week.

2. ***Figure the mean ($\bar{X}$) and the range for each subgroup, and summarize it in a table.*** Then design two time order graphs, one for the mean, and one for the range, and plot the means of the subgroup on one chart and the ranges on the other.

3. ***Calculate the overall mean ($\bar{X}$**) and the overall range ($\bar{R}$), totaling each the means and the ranges, and dividing each by the number of occurrences (e.g., weeks).*** Plot each of these on the appropriate time order plot.

4. ***Figure the Upper Control Limit (UCL) and Lower Control Limit (LCL) for the mean chart, and plot them.*** Use the following equations:

$$UCL = \bar{X}^{**} + (A_2 \times \bar{R})$$

$$LCL = \bar{X}^{**} - (A_2 \times \bar{R})$$

where A_2 is a constant found in Table 1

5. ***Figure the Upper Control Limit (UCL) and Lower Control Limit (LCL) for the range chart and plot them.*** Use the following equations:

$$UCL = D_4 \times \bar{R}$$

$$LCL = D_3 \times \bar{R}$$

where D_3 and D_4 are constants found in Table 1

VARIABLE DATA, MEAN AND RANGE CHARTS: EXAMPLE

1. Collect at least 40 data points in time sequence. You must collect them in *sets* of two or more and average them, so you have at least 20. These sets are called subgroups. A subgroup might consist of the average of two different readings over a week.

---------- OBSERVATION NUMBER ----------

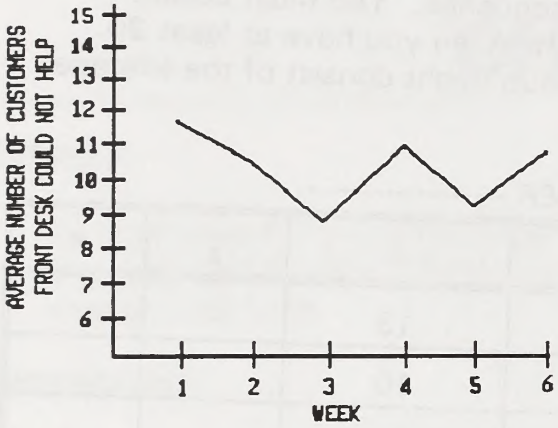
WEEK	1	2	3	4	$\bar{X}$	R
1	7	13	13	13		
2	9	11	12	10		
3	13	7	7	8		
4	12	11	12	10		
5	9	9	10	9		
5	7	12	13	11		
				TOTALS =		

2. Figure the mean ($\bar{X}$) and the range for each subgroup, and summarize it in a table. Then design two time order graphs, one for the mean, and one for the range, and plot the means of the subgroup on one chart and the ranges on the other (see next page).

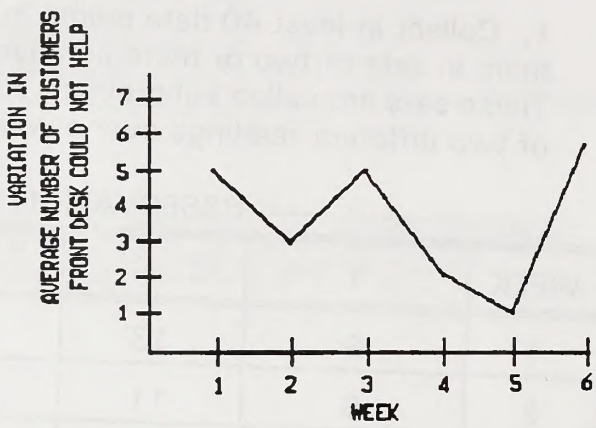
---------- OBSERVATION NUMBER ----------

WEEK	1	2	3	4	$\bar{X}$	R
1	9	13	13	13	11.75	5
2	9	11	12	10	10.5	3
3	13	7	7	8	8.75	5
4	12	11	12	10	11.25	2
5	9	9	10	9	9.25	1
6	7	12	13	11	10.75	5
				TOTALS =	62.25	22

VARIABLE DATA, MEAN AND RANGE CHARTS: EXAMPLE, CONTINUED



PLOT OF AVERAGES, MEAN CHART

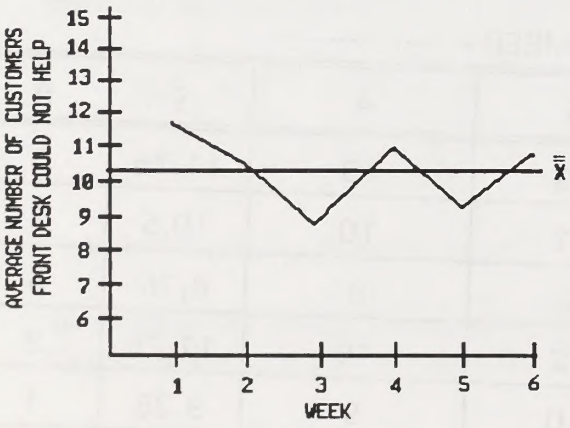


PLOT OF RANGES CHART

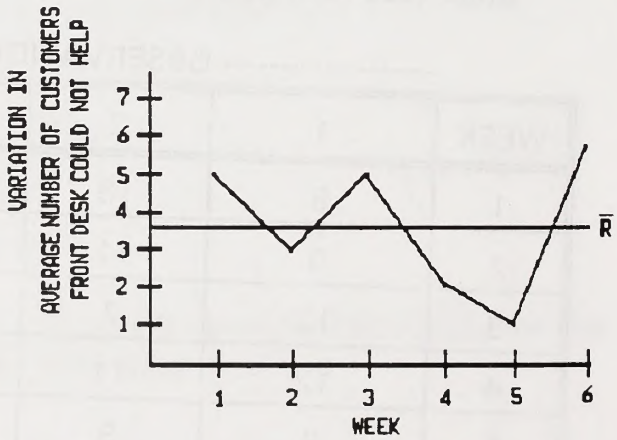
3. Calculate the overall mean ($\bar{X}^{**}$) and the overall range ($\bar{R}$), totaling each the means and the ranges, and dividing each by the number of occurrences (e.g., weeks). Plot each of these on the appropriate time order plot.

$$\bar{X}^{**} = 62.25/6 = 10.38$$

$$\bar{R} = 22/6 = 3.67$$



PLOT OF AVERAGES, MEAN CHART, WITH X**



PLOT OF RANGES CHART, WITH R**

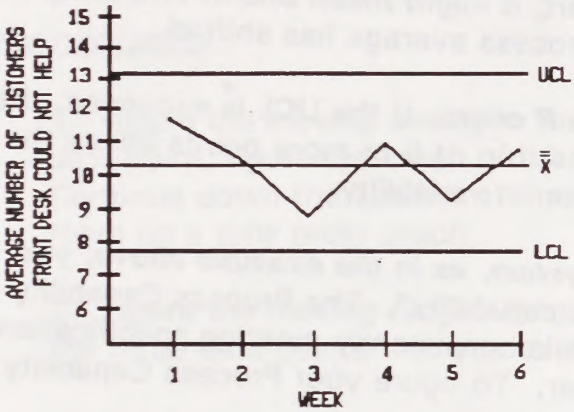
VARIABLE DATA, MEAN AND RANGE CHARTS: EXAMPLE, CONTINUED

4. Figure the Upper Control Limit (UCL) and Lower Control Limit (LCL) for the mean chart, and plot them. Use the following equation:

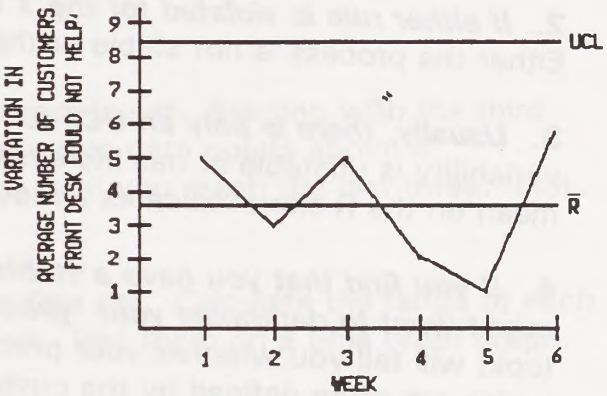
$$UCL = \bar{X}^{**} + (A_2 \times \bar{R}): \quad UCL = 10.38 + (0.729 \times 3.67) = 13.1$$

$$LCL = \bar{X}^{**} - (A_2 \times \bar{R}): \quad LCL = 10.38 - (0.729 \times 3.67) = 7.7$$

where A_2 is a constant found in Table 1



MEAN CHART WITH UCL AND LCL



RANGE CHART WITH UCL

5. Figure the Upper Control Limit (UCL) and Lower Control Limit (LCL) for the range chart and plot them. Use the following equation:

$$UCL = D_4 \times \bar{R}: \quad UCL = 2.282 \times 3.67 = 8.4$$

$$LCL = D_3 \times \bar{R}: \quad LCL = 0 \times 3.67 = 0$$

where D_3 and D_4 are constants found in Table 1

CONTROL CHART: VARIABLE DATA, MEAN AND RANGE CHARTS

INTERPRETATIONS:

1. ***Two rules apply to both the $\bar{X}$ and the R charts:***

   a. No points should fall outside of the control limits

   b. No runs of 8 or more points should fall on either side of the mean on the chart

2. ***If either rule is violated for the $\bar{X}$ chart, it might mean one of two things.*** Either the process is not stable or the process average has shifted.

3. ***Usually, there is only an UCL for the R chart.*** If the UCL is exceeded, the variability is unstable or has increased. A run of 8 or more points below the mean on the R chart indicates a reduction in variability.

4. ***If you find that you have a stable system, as in the example above, you might want to determine your "process capability".*** The Process Capability (cpk) will tell you whether your process is consistently meeting specifications, which are often defined by the customer. To figure your Process Capability:

   a. Complete both $\bar{X}$ and R control charts.

   b. Determine what your specification limit is, e.g., how many days it should take to complete an EA.

   c. Using the information that you generated from your control charts, compute the following formula:

   cpk = (distance from process mean to nearest spec limit)/(3 x s)

   where s = $\bar{R}/d_2$; see Appendix II for another way to compute s (standard deviation)

   d. A cpk that is equal to or greater than 1.33 is considered to be adequate. In the control chart example above, with a process specification of 15 and a standard deviation of 1.78:

   cpk = (15 - 10.38)/(3 X 1.78) = .87

   therefore, the service is probably NOT consistently meeting customer expectations

CONTROL CHART: VARIABLE DATA, MOVING AVERAGE CHARTS

PURPOSE:

To determine the expected range of variation in variable (vs. attribute) data over time within statistical limits, to identify the outliers, and to gauge change over time, when your data set is limited in size and it is not practical to group the data into subgroups.

PROCEDURES:

1. ***Figure the moving averages for your data set.*** Starting with the third data point, figure the mean of it and the two data points above it. Continue down the column of numbers until you reach the last three. Plot them on a time order graph.

2. ***Figure the moving ranges for your data set.*** Calculate the range of each of the three data points that you averaged. Plot them on a time order graph.

3. ***Calculate the overall mean of the moving averages ($\bar{X}$**) and the mean of the moving ranges ($\bar{R}$) and plot them on the appropriate graph.***

4. ***Figure the Upper Control Limit (UCL) and Lower Control Limit (LCL) for the mean chart, and plot them.*** Use the following equations:

$$UCL = \bar{X}^{**} + (A_2 \times \bar{R})$$

$$LCL = \bar{X}^{**} - (A_2 \times \bar{R})$$

where $A_2 = 1.023$ (for moving averages of 3)

5. ***Figure the Upper Control Limit (UCL) for the range chart and plot them.*** Use the following equation:

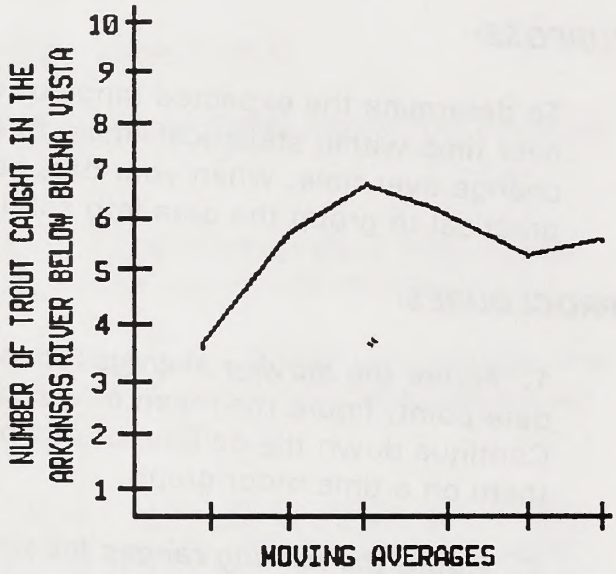
$$UCL = D_4 \times \bar{R}$$

where $D_4 = 2.574$ (for moving averages of 3)

VARIABLE DATA, MOVING AVERAGE CHARTS EXAMPLE

1. Figure the moving averages for your data set. Starting with the third data point, figure the mean of it and the two data points above it. Continue down the column of numbers until you reach the last three. Plot them on a time order graph.

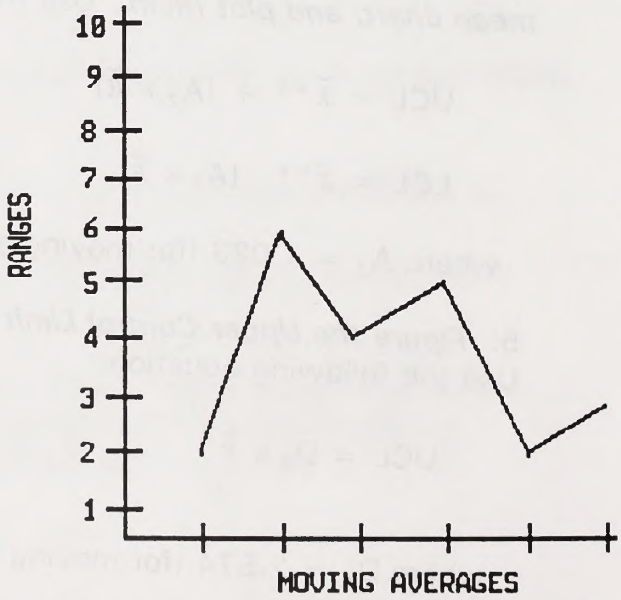
DATA POINT	MOVING AVERAGE	RANGE
9		
3		
6	3.7	
9	5.7	
6	6.7	
4	6.3	
6	5.3	
7	5.7	



MOVING AVERAGE MEAN CHART

2. Figure the moving ranges for your data set. Calculate the range of each of the three data points that you averaged. Plot them on a time order graph.

DATA POINT	MOVING AVERAGE	RANGE
3		
3		
6	3.7	2
9	5.7	6
6	6.7	4
4	6.3	9
6	5.3	2
7	5.7	3

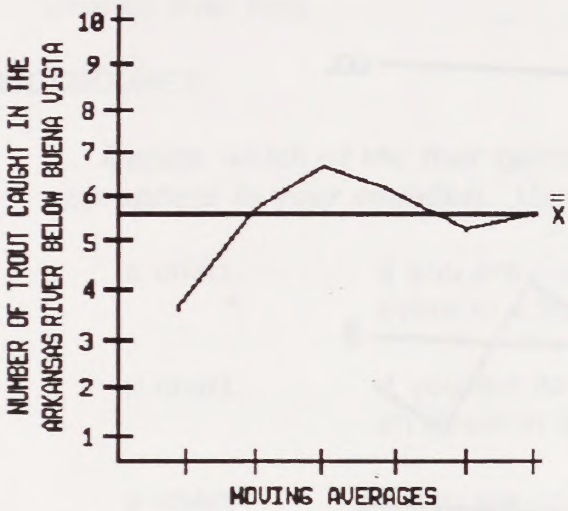


MOVING AVERAGE RANGE CHART

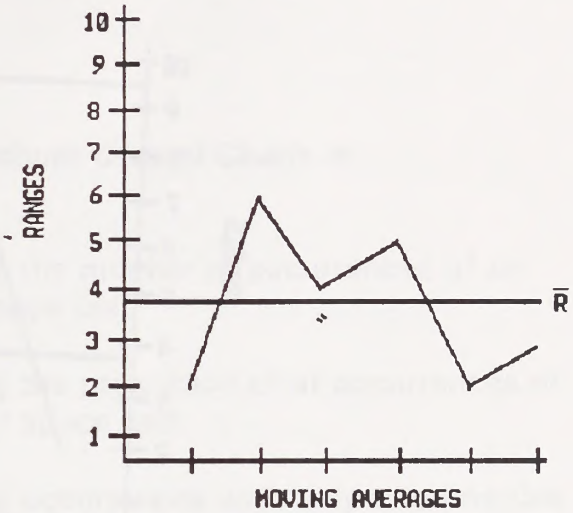
VARIABLE DATA, MOVING AVERAGE CHARTS EXAMPLE, CONTINUED

3. Calculate the overall mean of the moving averages ($\bar{X}^{**}$) and the mean of the moving ranges ($\bar{R}$) and plot them on the appropriate graph:

$$\bar{X}^{**} = 5.6; \quad \bar{R} = 3.7$$



MOVING AVERAGE MEAN CHART

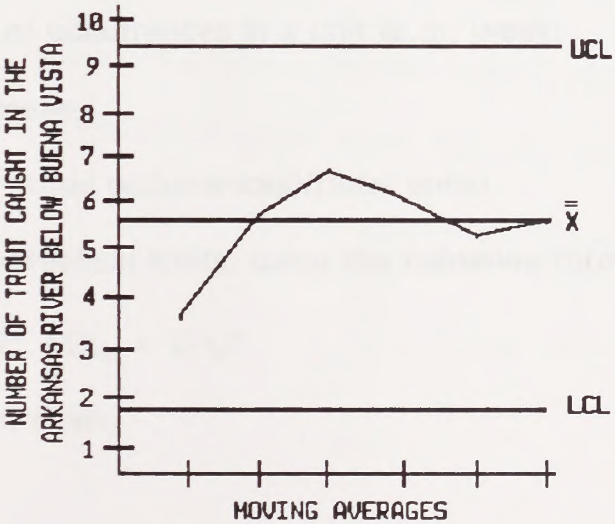


MOVING AVERAGE RANGE CHART

4. Figure the Upper Control Limit (UCL) and Lower Control Limit (LCL) for the mean chart, and plot them. Use the following equations:

$$UCL = \bar{X}^{**} + (A_2 \times \bar{R}): \; 5.6 + (1.023 \times 3.7) = 9.4$$

$$LCL = \bar{X}^{**} - (A_2 \times \bar{R}): \; 5.6 - (1.023 \times 3.7) = 1.8$$

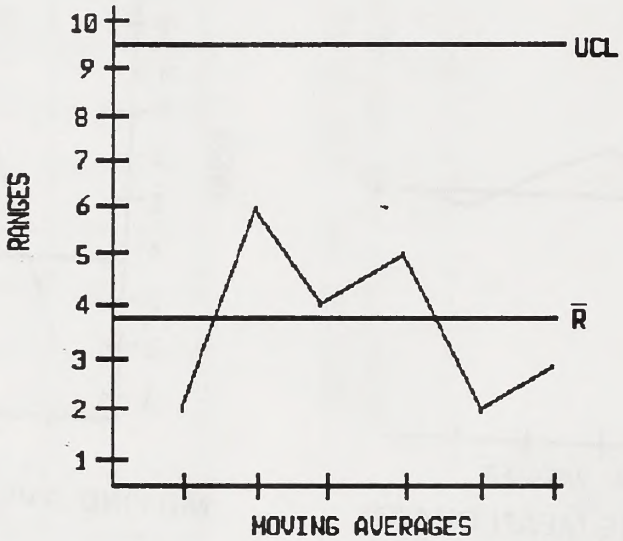


MOVING AVERAGE MEAN CHART

VARIABLE DATA, MOVING AVERAGE CHARTS EXAMPLE, CONTINUED

5. ***Figure the Upper Control Limit (UCL) for the range chart and plot them.*** Use the following equation:

$$UCL = D_4 \times \bar{R}: \ 2.574 \times 3.7 = 9.5$$



MOVING AVERAGE RANGE CHART

CONTROL CHART: ATTRIBUTE DATA

PURPOSE:

To determine the expected range of variation in attribute (vs. variable) data over time within statistical limits, to identify the outliers, and to gauge change over time.

PROCEDURES:

1. ***Decide which of the four types of Attribute Control Charts is appropriate to your situation.*** Use a:

c chart	if you are comparing the number of occurrences of an event in a time or space unit
u chart	if you are comparing the proportion of of occurrences of an event in a time or space unit
p chart	if you are comparing occurrences with only two possible outcomes (dichotomous variables)
np chart	if you are comparing occurrences with only two possible outcomes (dichotomous variables) and the sample size is constant

2. ***For c charts:***

a. Collect the data in time sequence.

c = number of occurrences in a unit (e.g., week)

b. Calculate the mean.

$\bar{c} = \sum c/n$ = (total occurrences)/(total units)

c. Calculate the statistical limits, using the following formulae:

$UCL_c = \bar{c}+3\sqrt{\bar{c}}$; $LCL_c = \bar{c}-3\sqrt{\bar{c}}$

d. Plot the control chart.

CONTROL CHART: ATTRIBUTE DATA, CONTINUED

3. *For u charts:*

a. Collect the data in time sequence.

u = c/n; where u = proportion of occurrences, c = number of occurrences in a time or space unit, and n = sample size in a time or space unit

b. Calculate the mean.

$3\bar{u} = \sum c / \sum n$ = (number of occurrences)/(sample size)

c. Calculate the statistical limits, using the following formulae:

$UCL_u = \bar{u} + 3\sqrt{\bar{u}/\bar{n}}$; $LCL_u = \bar{u} - 3\sqrt{\bar{u}/\bar{n}}$
where $\bar{n}$ = total number of occurrences/number of groups

d. Plot the control chart.

4. *For p charts:*

a. Collect the data in time sequence.

p = proportion of the occurrences of the outcome of interest

b. Calculate the mean.

$\bar{p}$ = average proportion over a period of time or space

c. Calculate the statistical limits, using the following formulae:

$UCL_p = \bar{p} + 3\sqrt{\bar{p}(1-\bar{p})/\bar{n}}$; $LCL_p = \bar{p} - 3\sqrt{\bar{p}(1-\bar{p})/\bar{n}}$
where $\bar{n}$ = total number of occurrences/number of groups

d. Plot the control chart.

CONTROL CHART: ATTRIBUTE DATA, CONTINUED

5. *For np charts:*

a. Collect the data in time sequence.

np = number of occurrences of interest; where n = sample size for each occurrence and p = proportion of occurrences of interest

b. Calculate the mean.

$n\bar{p}$ = average of np values over a period of time or space

c. Calculate the statistical limits, using the following formulae:

$$UCL_{np} = n\bar{p} + 3\sqrt{n\bar{p}(1-\bar{p})}; \quad LCL_{np} = n\bar{p} - 3\sqrt{n\bar{p}(1-\bar{p})}$$

d. Plot the control chart.

CONTROL CHART: ATTRIBUTE DATA, EXAMPLE

c charts:

a. Collect the data in time sequence.

c = number of occurrences in a unit (e.g., week)

DAY	NUMBER OF DISGRUNTLED HUNTERS DURING HUNTING SEASON
1	3
7	4
3	7
4	9
5	14
6	26
7	27
5	23
5	13
10	11
11	13
12	18

b. Calculate the mean.

$\bar{c} = \sum c/n$ = (total occurrences)/(total units)

$\bar{c} = 168/12 = 14$

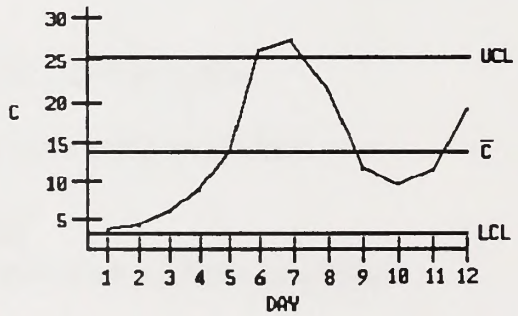
c. Calculate the statistical limits, using the following formulae:

$UCL_c = \bar{c}+3\sqrt{\bar{c}}$; $LCL_c = \bar{c}-3\sqrt{\bar{c}}$

$UCL_c = 14 + 3\sqrt{14} = 25.2$

$LCL_c = 14 - 3\sqrt{14} = 2.8$

d. Plot the control chart.



CONTROL CHART: ATTRIBUTE DATA, EXAMPLE

u charts:

a. Collect the data in time sequence.

u = c/n; where u = proportion of occurrences, c = number of occurrences in a time or space unit, and n = sample size in a time or space unit

NUMBER OF ERRORS ON RANGE BILLS BY RANGE CONS

WEEK	1	2	3	4	u
1	1	4	7	4	4
2	2	3	6	5	4
3	1	1	1	4	1.75
4	3	3	2	4	3
5	2	5	1	4	3
6	1	2	5	3	2.75

b. Calculate the mean.

$\bar{u} = \sum c / \sum n$ = (number of occurrences)/(sample size)

$\bar{u} = 74/24 = 3.08$

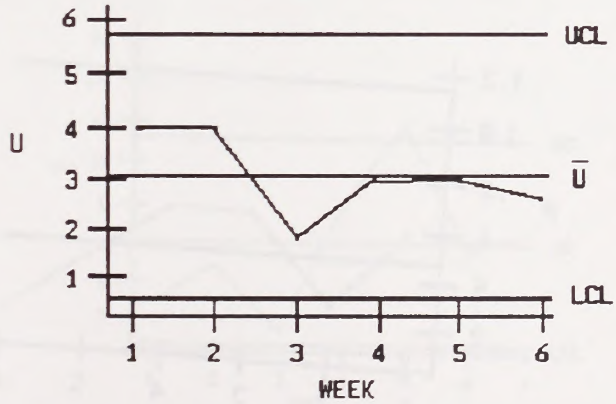
c. Calculate the statistical limits, using the following formulae:

$UCL_u = \bar{u} + 3\sqrt{\bar{u}/\bar{n}}$; $LCL_u = \bar{u} - 3\sqrt{\bar{u}/\bar{n}}$ where $\bar{n}$ = total number of occurrences/number of groups

$UCL_u = 3.08 + 3\sqrt{3.08/4} = 5.68$

$LCL_u = 3.08 - 3\sqrt{3.08/4} = .48$

d. Plot the control chart.



CONTROL CHART: ATTRIBUTE DATA, EXAMPLE

p charts:

a. Collect the data in time sequence.

p = proportion of the occurrences of the outcome of interest

DAY	NUMBER OF SITES WITH HAZARDOUS MATERIALS	p
1	3/5	.60
2	1/4	.25
3	2/3	.66
4	4/6	.66
5	2/5	.40
6	1/5	.20

b. Calculate the mean.

$\bar{p}$ = average proportion over a period of time or space

$\bar{p} = 2.77/6 = .46$

c. Calculate the statistical limits, using the following formulae:

$UCL_p = \bar{p}+3\sqrt{\bar{p}(1-\bar{p})/\bar{n}}$;

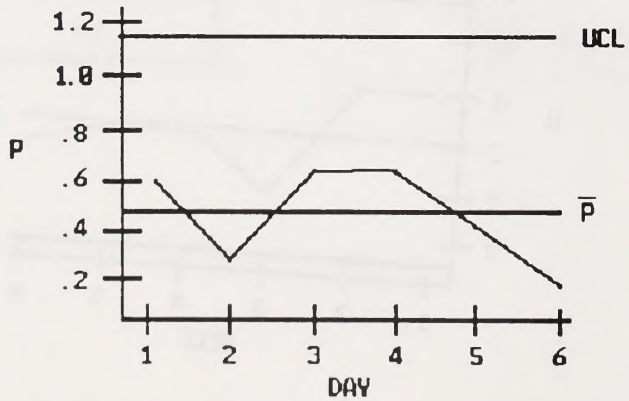
$LCL_p = \bar{p}-3\sqrt{\bar{p}(1-\bar{p})/\bar{n}}$

where $\bar{n}$ = total number of occurrences/number of groups

$UCL_p = .46 + 3\sqrt{.46(1-.46)/4.7} = 1.15$

$LCL_p = .46 - 3\sqrt{.46(1-.46)/4.7} = 0$

d. Plot the control chart.



CONTROL CHART: ATTRIBUTE DATA, EXAMPLE

np charts:

a. Collect the data in time sequence.

np = number of occurrences of interest; where n = sample size for each occurrence and p = proportion of occurrences of interest

NUMBER OF HOURS MEETING ROOM BOOKED (8 AM - 10 PM)

DAY	HOURS	p	np
1	3/14	.21	3
2	5/14	.36	5
3	1/14	.07	1
4	8/14	.57	6
5	12/14	.86	12
6	6/14	.43	6
7	7/14	.50	7

b. Calculate the mean.

$n\bar{p}$ = average of np values over a period of time or space

$n\bar{p} = (14).43 = 6.02$

c. Calculate the statistical limits, using the following formulae:

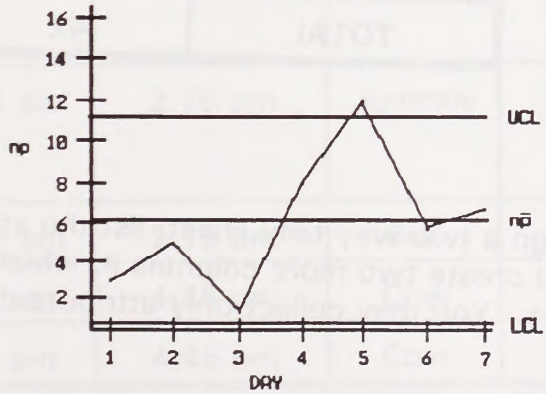
$UCL_{np} = n\bar{p} + 3\sqrt{n\bar{p}(1-\bar{p})}$

$LCL_{np} = n\bar{p} - 3\sqrt{n\bar{p}(1-\bar{p})}$

$UCL_{np} = 6.02 + 3\sqrt{6.02(1-.43)} = 11.62$

$LCL_{np} = 6.02 - 3\sqrt{6.02(1-.43)} = .42$

d. Plot the control chart.



DATA GATHERING

PURPOSE:

To collect information for the purposes of evaluating processes.

PROCEDURES:

1. ***Decide on which statistical tests you wish to perform, whether they are simply graph-making or as complicated as multi-variate analysis.*** Another form of data-gathering is through customer surveys. The following methods are to be performed by the agency.

2. ***There are two common types of data collection tools.*** *Tally sheets* are simply counting devices, while *data logs* may record a large amount of information about each observation.

a. To design a tally sheet, list the attribute to be counted in one column and create another column in which to record the number of occurrences:

TALLY SHEET: Number of Animals Observed in Phantom Canyon

ANIMALS	NUMBER
Spotted owls	xx
Bighorn sheep	xxxxxxx
Coyotes	x
Deer	xxxxxxxxxxx xxxxxxxxxxx xxxxx
Cottontail rabbits	xxxxx
TOTAL	42

b. To design a two-way tally sheet, list the attribute to be counted in one column and create two more columns in which to record the discrete occurrences. You may collect only attribute data with tally sheets:

TWO-WAY TALLY SHEET: Number of Visitors to Hecla Junction Recreation Area

REASON	MEN	WOMEN	TOTAL
Fishing	xxxxxxx	xx	9
Rafting	xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxx	xxxxxxxx xxxxxxxx xxxxxxxx xxxxxx	75
Hiking	x	x	2
Picnicking	xxxxx	xxxxxxxx xxx	16
Viewing wildlife		x	1
TOTAL	58	45	103

c. To design a data log, include as many columns as you need, but remember that times are almost always included. You may collect both attribute and variable data using data logs:

DATA LOG: Cattle Approaching Badger Creek

OWNER	TIME OF ARRIVAL	TIME OF DEPARTURE	GENDER	REASON	HEALTH OF ANIMAL
Fuller	11:05 am	2:15 pm	Cow	Drink and graze	E
Fuller	11:05 am	2:15 pm	Juvenile	Drink and graze	E
Miller	11:30 am	2:15 pm	Bull	Drink	E
Harrison	4:15 pm	4:45 pm	Cow	Graze	F
Little	4:25 pm	4:45 pm	Cow	Graze	P

DATA GATHERING TIPS AND FURTHER INFORMATION

FOR MORE HELP WITH DATA GATHERING:

The Memory Jogger, pp. 14 - 16

TIPS

▹ Instead of using "x"s on the tally sheets, you may also use tick marks, and separate them into groups of five (e.g., IIII)

▹ Be consistent in how you collect the data; don't "fudge" them.

DECISION MATRIX

PURPOSE:

To evaluate and compare ideas based on their relative importance.

PROCEDURES:

1. ***List all ideas under consideration.*** These might be potential problems or solutions that need comparison.

2. ***Narrow the list to six or fewer candidates.*** You can combine similar ideas or ask everyone to list their top three, and eliminate the least popular ones.

3. ***Establish criteria to weigh the ideas.*** Some examples:

   ✓ Impact on customer satisfaction

   ✓ Potential savings

   ✓ Practicality

   ✓ Probability of success

   ✓ Time needed

4. ***Assign each criterion a weight.*** Non-mandatory criteria may be rated on a scale from 1-10. Mandatory criteria, e.g., consideration of safety, legality, ethics, must be rated as "yes" or "no", and could eliminate the idea if not met.

5. ***List the ideas and criteria in a table (next page).***

6. ***Compare each criterion with each idea.*** Score the how well the idea meets the criterion in the "Id Rtg" column.

7. ***Calculate a weighted score for each combination.*** Multiply the criteria weights by the idea scores, and place the result in the "Wtd Rtg" column.

8. ***Calculate a total score for each idea.*** Add all of the idea scores and place the total in the column on the far right.

DECISION MATRIX EXAMPLE

IDEA	TIME SAVINGS WT. = 10		EXTERNAL CUSTOMER IMPACT WT. = 5		FEASIBILITY WT. = 8		INTERNAL CUSTOMER IMPACT WT. = 8		TOTAL WEIGHTED RATING FOR EACH IDEA
	ID RTG	WTD RTG	ID RTG	WTD RTG	ID RTG	WTD RTG	ID RTG	WTD RTG	
USE A ONE-PAGE FORM FOR EAs	10	100	2	10	7	56	10	80	246
DO NOT ROUTE Eas FOR SIGNING	10	100	5	25	3	24	10	80	229
USE A FAIL-SAFE METHOD FOR CHECKING	3	30	5	25	10	80	5	40	175

FOR MORE HELP WITH DECISION MATRICES:

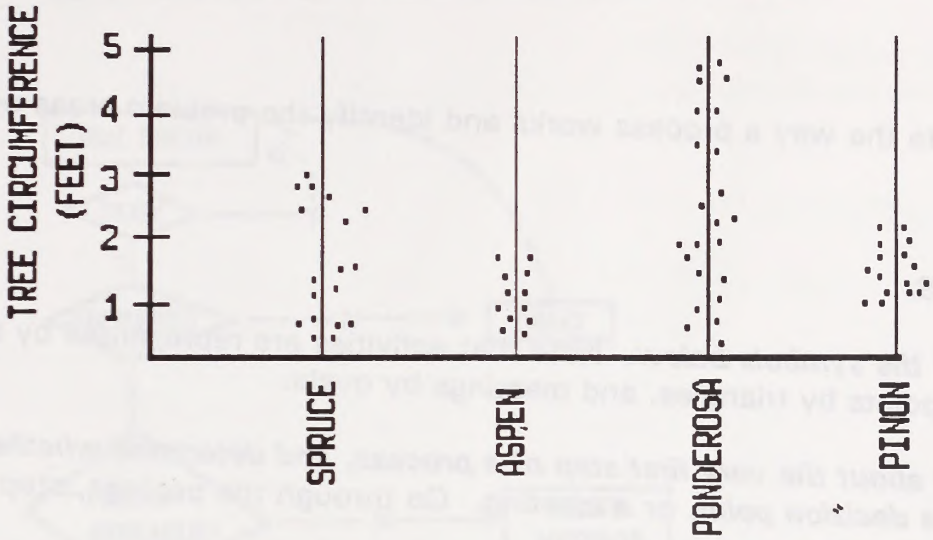
Use the Decision Matrix worksheet in Appendix I.

See your TQM coordinator.

TIPS

- Always work vertically. This will allow ideas, vs. criteria, to be compared.
- Assign reasonable weights to your ideas, and get team consensus

DOT PLOT



PURPOSE:

For a quick comparison of the distribution of data in several data sets.

PROCEDURES:

1. ***Draw a baseline, and list the relevant data sets evenly along the line.***
2. ***For each observation, plot a dot on the graph. Array the dots vertically.***

FOR MORE HELP WITH DOT PLOTS:

The Team Handbook, p. 2-34

TIPS

▹ Dot plots work best with a relatively small data set, unless the dots represent more than one observation.

▹ Dot plots are not appropriate for time-related data.

FLOW CHARTS

PURPOSE:

To evaluate the way a process works and identify the problem areas or use as a guide.

PROCEDURES:

1. ***Study the symbols below.*** Note that activities are represented by squares, decision points by triangles, and meetings by ovals.

2. ***Think about the very first step of a process, and determine whether it is an activity, a decision point, or a meeting.*** Go through the process, step by step, overlooking none.

3. ***Join the steps with arrows and/or lines.*** Following a decision point, place a "Y" (for yes) or "N" (for no) in the middle of the joining line or arrow. You may use other dichotomous variables as well.

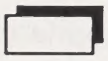
4. ***For a simple flow chart*** (illustrated on the next page), follow the process, placing the players inside the symbols if necessary. A simple flow chart differs from a deployment flow chart, since it is not structured by the players.

5. ***For a deployment flow chart***, list the major players above the flow chart, and organize it by their activities and interactions (see the illustration on the next page).

FLOW CHART SYMBOLS

= ACTIVITIES

= DECISION POINTS

 = SUB-PROCESS

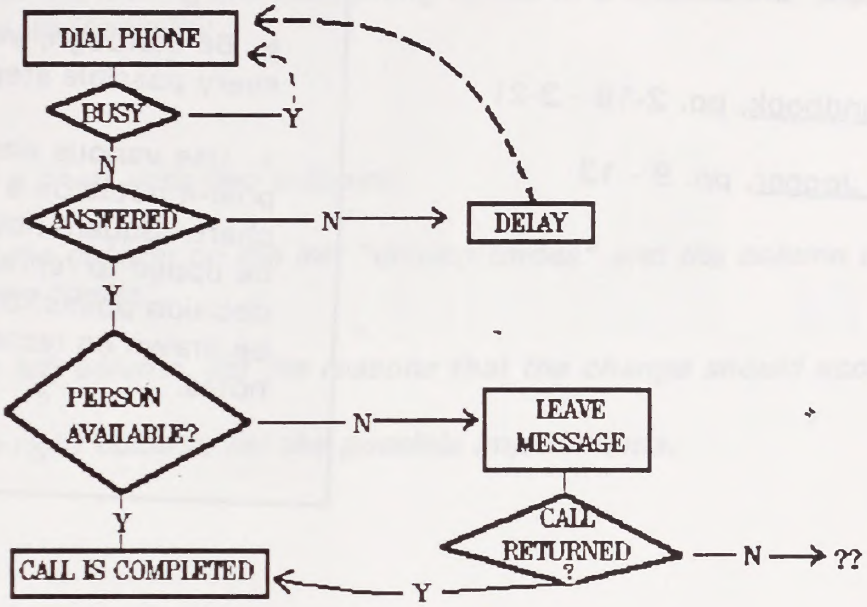
= MEETING

- - - - - - = UNFAVORABLE OUTCOMES THAT REQUIRE AN ACTIVITY TO BE REPEATED

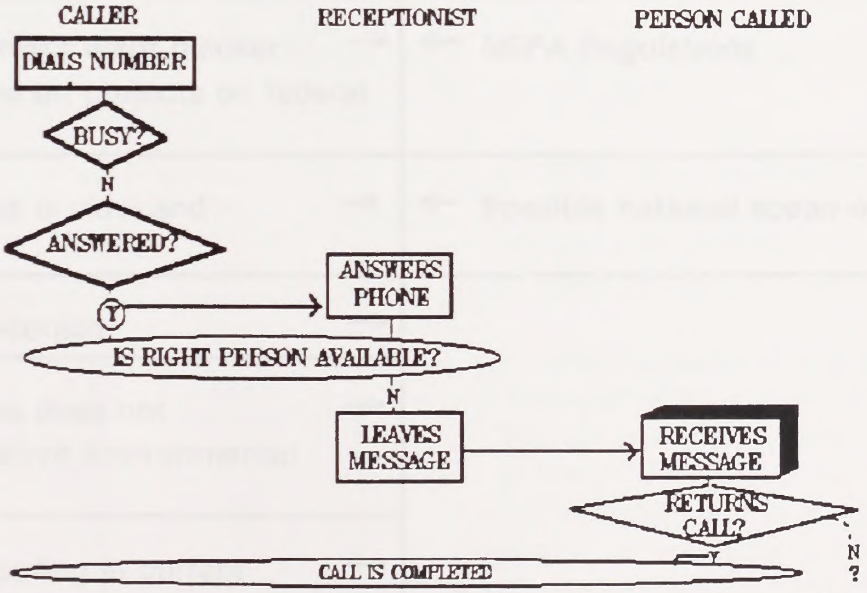
= PARTIES THAT CONTRIBUTE TO AN OUTCOME BY PROVIDING A SERVICE

FLOW CHARTS, ILLUSTRATIONS

SIMPLE FLOW CHART: PLACING A BUSINESS CALL



DEPLOYMENT FLOW CHART: PLACING A BUSINESS CALL



FLOW CHART TIPS AND FURTHER INFORMATION

FOR MORE HELP WITH FLOW CHARTS:

The Team Handbook, pp. 2-18 - 2-21

The Memory Jogger, pp. 9 - 13

TIPS

▹ Be thorough; include every possible step.

▹ Use various sizes of post-it notes on a flip chart. Square notes can be tipped to represent decision points; ovals can be drawn on rectangular notes.

FORCE FIELD ANALYSIS

PURPOSE:

To analyze the driving and restraining forces of a desired change, and thus determine its feasibility.

PROCEDURES:

1. ***Draw a chart with two columns.***

2. ***Label the column on the left "driving forces" and the column on the right "restraining forces".***

3. ***In the left column, list the reasons that the change should occur.***

4. ***In the right column, list the possible impediments.***

REASONS TO CHANGE EA PROCESS

DRIVING FORCES	RESTRAINING FORCES
External customers want quicker turnaround time on projects on federal land →	← NEPA Regulations
Current process is slow and inefficient →	← Possible national scope of problem
Lawsuit in Wisconsin →	
Current process does not adequately analyze environmental impacts →	
No mistake-proofing in current process →	

FORCE FIELD ANALYSIS TIPS AND FURTHER INFORMATION

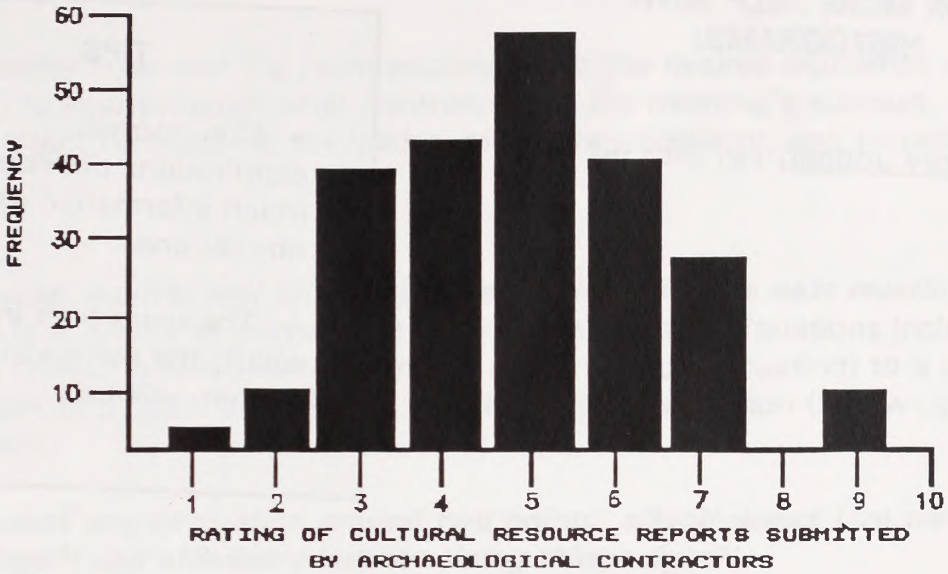
FOR MORE HELP WITH FORCE FIELD ANALYSIS:

The Memory Jogger, pp. 72 - 73

TIPS

- Be as inclusive as possible; don't bias the analysis by purposely excluding something.
- The number of forces in each column does not necessarily mean one set of forces is less important than the other. Weigh the importance of each force.
- As long as restraining and driving forces resist each other, change cannot occur. The challenge is to increase the driving forces and reduce the restraining forces.

HISTOGRAM (BAR CHART)



PURPOSE:

To analyze the distribution of measurement data.

RATING	FREQUENCY
1	4
2	10
3	48
4	43
5	58
6	38
7	25
8	4
9	10
10	0

PROCEDURES:

1. ***Draw a graph.***

2. ***Array the frequency range along the Y-axis.***

3. ***After plotting the data points, draw a bar, centered around the point.*** The bars do not need to be discrete, as they are in the illustration above.

4. ***The example above illustrates a "normal" distribution.*** If the bars to the left are higher, they are "skewed to the left"; if the ones to the right are higher, they are "skewed to the right". If two high points are present, the distribution is "bimodal".

HISTOGRAM TIPS AND FURTHER INFORMATION

FOR MORE HELP WITH HISTOGRAMS:

The Memory Jogger, pp. 36 - 43

TIPS

▹ Non-normal distributions provide as much information as do normal ones.

▹ The more bars in a chart, the more visible a pattern will be.

MEETING EVALUATION

PURPOSE

To determine how well the team accomplished the desired outcomes of the meeting, to acknowledge what contributed to the meeting's success, and to provide direct feedback to the leader, members, facilitator, and recorder.

PROCEDURES

1. ***List what worked and what could be improved for the next meeting.*** This can be done in a variety of ways, with more or less detail. Variations include a light meeting review (a few short comments at the end of a meeting) to a medium review (list of plusses and deltas), to an in-depth evaluation (follow-up interviews).

2. ***Structure any evaluation around two points: effectiveness (are we doing the right things?) and efficiency (are we doing things right?).***

3. ***If you wish, you may do both a general evaluation and a focused evaluation on how well the group discussed specific topics.***

For a general evaluation, answer the following questions:

- How did this meeting go?
- What didn't we like?
- How was the pace, flow, and tone of the meeting?
- Did we handle items in a reasonable sequence?
- Did we get stuck?
- What might we do differently?
- What should we do that we didn't do?
- What was just right and should continue as is?

For a focused evaluation, answer the following questions:

- How well did we stay on (any specified) subject?
- Did we look for problems in the system rather than blame individuals?
- How well did we discuss the information? How clearly?
- How well did we respond to each other's questions? How satisfied are we with answer to our questions?

MEETING EVALUATION TIPS AND FURTHER INFORMATION

FOR MORE HELP WITH MEETING EVALUATIONS:

The Team Handbook, p. 4-33

Use the Meeting Evaluation Forms in Appendix I.

TIPS

▹ Provide a short list of evaluation items and rate each on a six point scale. Discuss differences in ratings.

▹ Place an item midpoint in the agenda entitled "Taking a look at how we doing".

MEETING RECORD

PURPOSE

Meeting minutes are used to remind team members about points of discussion, tasks to be performed between meetings, decisions made, and responsibilities which have been assigned. They help managers, and others who receive copies, to understand the issues and challenges facing the project team. They are also part of historical record of the teams's progress, and can provide useful information for future teams making further improvements to the same process.

PROCEDURES

1. ***The minutes should always contain the same information:***

   ◇ date and time of meeting

   ◇ names of people attending

   ◇ topics discussed and main points made in each discussion

   ◇ action taken or decisions made

   ◇ tasks to be performed between meetings and items to be carried over to future agendas

2. ***Effective minutes are brief, well organized, clear, legible, accurate, report the appropriate amount of information and are distributed soon after the meeting.***

3. ***When you are composing your meeting record, consider the following:***

   Audience: To whom will the minutes be distributed?

   Use: How will the minutes be used? For documentation, reminder for tasks to be performed between meetings, etc.?

4. ***There are two types of minutes:***

   Brief minutes: The audience is only those who participated in the meeting. They are used as a reminder of agreements and follow-up actions.

   Edited minutes: The audience includes a significant number of non-participants. They are used to provide information to non-participants.

5. ***Alternative Meeting Record Format: Project teams may use a "meeting record" format tailored to meet the needs of the team instead of taking formal minutes at each meeting.***

Picture Book Format: displays the milestones in a project through a series of flowchart-like entries. The first three segments of a Picture Book are standard: Project, Reason Selected, and Situation Analysis. Other segments depend on the project. Some typical items include: Data Collection, Data Analysis, Goal, Actions, and Evaluation. There is an sample Picture Book Format in The Team Handbook on page 4-14.

Project Team Meeting Record: displays the information in a series of boxes. Each box contains space for the recorder to capture a brief description and the main points associated with each topic presented, decisions and conclusions reached, and the next steps to be taken. Discussion are written in a summarized format.

FOR MORE HELP WITH MEETING EVALUATIONS:

How to Make Meetings Work, p. 139-142

The Team Handbook, p. 4-9, 4-14

TIPS

- You may distribute hard copies of your minutes or send them on the computer.
- Try to distribute the minutes within a week after the meeting.

MISTAKE-PROOFING

PURPOSE:

To provide a system of process checks that eliminates mistakes.

PROCEDURES:

1. ***Define the present process.***
2. ***Brainstorm for error possibilities.***
3. ***Rate the errors for their:***
   a. Likelihood [(L)ow, (M)edium or (H)igh]
   b. Severity [(L)ow, (M)edium or (H)igh]
4. ***Select the most likely and severe errors and:***
   a. Determine the causes
   b. Develop a method for eliminating the causes

FOR MORE HELP WITH MISTAKE-PROOFING:

Use the Mistake-proofing worksheets in Appendix I.

See your TQM coordinator.

TIPS

▹ Evaluate your new methods after they have been in use for a while to determine whether they are working.

▹ Make sure that your worksheets are keyed to each other; use the same wording if possible.

MISTAKE-PROOFING WORKSHEET: PROCESS ANALYSIS

"ARCHAEOLOGICAL CLEARANCES"

PROCESS STEPS	POSSIBLE ERRORS	LIKELIHOOD	SEVERITY	ACTION?
1. Receive request for inventory	• wrong locational information	L	H	no
	• wrong information about permission to cross private land	M	H	YES
2. Do a literature review	• analyze wrong township	L	L	no
3. Do the fieldwork	• inventory wrong parcel	L	H	no
4. Complete the report and site forms	• leave out information	M	M	no
	• forget to do the site forms	M	H	YES
5. Prepare the SHPO letter, get it signed, send it	• leave out information	L	L	no
	• forget to have the letter signed by the area manager	L	M	no
6. Wait for the SHPO to return it, and give a copy of the signed SHPO letter to the resource specialist	• forget to make a copy	M	H	YES

MISTAKE-PROOFING WORKSHEET: MISTAKE-PROOFING METHODS

"ARCHAEOLOGICAL CLEARANCES"

POSSIBLE ERROR ACTIONS	IDEAS FOR CORRECTION	ADVANTAGES	DISADVANTAGES
1. Wrong information about permission to cross private land	• Archaeologist could call the private landowner to confirm • Archaeologist does not do work if has to cross private land	• Landowner is reminded and has the opportunity to speak to the person doing the work	• Archaeologist might forget • Work does not get done; project does not proceed
2. Forget to do the site forms	• Develop a checklist that must be filled in before survey report will print • Include a checklist with each SHPO letter	• Will remind the archaeologist to do the site forms • Will remind the archaeologist to do the site forms	• Will slow down the process when no site forms are necessary • Will generate extra paper
3. Forget to make copy of the SHPO letter	• ask staff assistant to make copy when letter is returned • wait for the resource specialist to remind the archaeologist • place a temporary reminder notice in each report file, which is removed when the letter is copied	• the archaeologist is no longer responsible • the archaeologist is no longer responsible • would remind the archaeologist to copy the letter	• would make extra work for the staff assistant • would make extra work for the resource specialist, and might not get into EA • archaeologist still might forget

NOMINAL GROUP TECHNIQUE

PURPOSE:

As an alternative to brainstorming, to generate ideas.

PROCEDURES:

1. ***Post the task on the wall.*** It is best to define it as a question, and make sure that everyone understands it.

2. ***Each team member writes down their ideas.*** Try to do this quietly, so no one is distracted.

3. ***Going around the room, each person contributes one idea.*** The ideas are written on the flip chart, and the round robin continues until all ideas are posted. Just like brainstorming, no discussion is allowed at this point.

4. ***Narrow down the list.*** Combine any like ideas, and, with the team's consensus, eliminate any unreasonable ones.

FOR MORE HELP WITH NOMINAL GROUP TECHNIQUE:

The Team Handbook, pp. 2-41 - 2-45

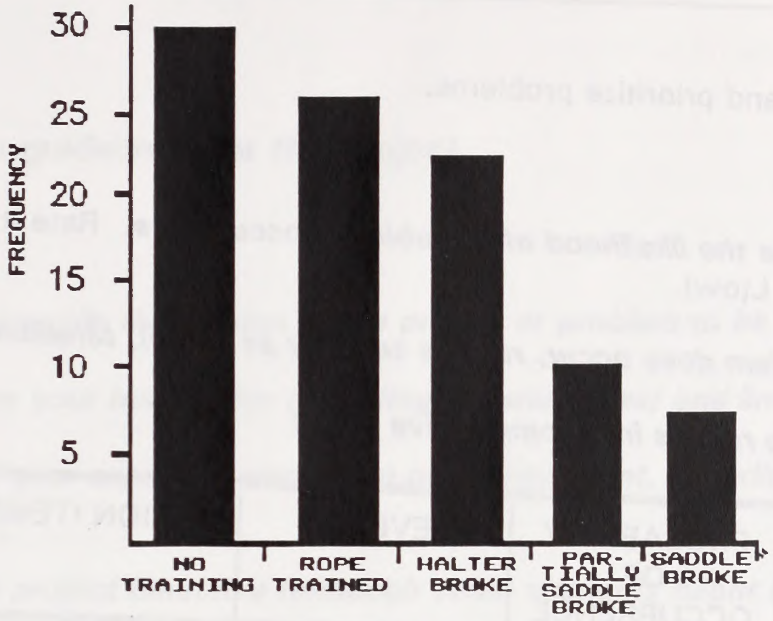
See your TQM coordinator.

TIPS

▹ The Nominal Group Technique is especially useful for controversial issues and when the team disagrees.

▹ A more formal method for winnowing the list can be found in The Team Handbook.

PARETO CHART



WILD HORSES

PURPOSE:

To graphically display frequencies of attribute data in descending order.

CATEGORY	FREQUENCY
No training	30
Rope trained	26
Halter broke	23
Partially saddle broke	10
Saddle broke	7

PROCEDURES:

1. ***Draw a graph.***

2. ***Array the frequency range along the Y-axis and the categories along the X-axis.***

3. ***After plotting the data points, draw a bar, centered around the point.***

FOR MORE HELP WITH PARETO CHARTS:

The Team Handbook, p. 2-25

The Memory Jogger, pp. 17 - 23

TIPS

▹ Pareto charts can be compared if the variables along one of the axes are the same.

PRIORITIZATION OF PROBLEMS

PURPOSE:

To compare and prioritize problems.

PROCEDURES:

1. ***Determine the likelihood of a problem's occurrence.*** Rate it as H(igh), M(edium) or L(ow).

2. ***If a problem does occur, rate its severity as H(igh), M(edium) or L(ow).***

3. ***Place the results in a comparative chart:***

PROBLEM	PROBABILITY OF OCCURRENCE	SEVERITY	ACTION ITEM?	ASSIGNED FOLLOWUP
Travel vouchers completed incorrectly	M	H	Yes	Travel coordinator (to educate employees)
Travel coordinator has no backup	H	H	Yes	Support services supervisor
Travel coordinator does not submit vouchers immediately	L	H	No	

FOR MORE HELP WITH PROBLEM PRIORITIZATION:

Use the Prioritization of Problems worksheet in Appendix I.

See your TQM coordinator.

TIPS

- Try to compare as many problems as possible.
- Be realistic about probabilities of occurrence and severity.

PROJECT MISSION STATEMENT

PURPOSE:

To develop guidelines for the project.

PROCEDURES:

1. ***Write a specific description of the project or problem to be solved.***

2. ***Determine your boundaries (including physical ones) and limiting factors.***

3. ***Consider your expected magnitude of improvement, including intangible improvements.***

4. ***Include a project timetable (although some elements might be open-ended).***

5. ***Develop a list of needed and available resources.***

6. ***Include a plan and schedule for involving management.***

7. ***GOOD QUALITY IMPROVEMENT PROJECTS:***

   a. ...involve a process that can be diagrammed.

   b. ...include measurable improvements.

   c. ...are subject to improvement, and not "untouchable".

FOR MORE HELP WITH PROBLEM PRIORITIZATION:

See your TQM coordinator.

TIPS

▷ Make a good copy of the mission statement, and give each team member one.

▷ Use it as a reference for refocusing the team when necessary.

QUESTIONNAIRES AND SURVEYS

PURPOSE:

To gather information about your process or problem from customers and other interested people.

PROCEDURES:

1. ***Identify the objectives of the questionnaire or survey.***

2. ***Prepare a schedule of activities.*** Allow at least two weeks for the respondents to return their completed questionnaires, longer if you are planning this during a busy time or peak vacation period. Determine who will be involved and how the survey will be sent and returned. Make it as clear and easy as possible for respondents.

3. ***Design the questionnaire.*** Categorize the questions for a logical flow. Consider how you will tabulate and compile the data and plan for this in your design. Personalize the questions by using the second person, "you." Prepare a draft questionnaire, referencing your objectives.

4. ***Prepare an introduction and instructions.*** The introduction should identify the purpose and logistics, and give an estimate of the amount of time that the questionnaire will take to complete. Confidentiality should also be addressed, and it is helpful to tell the respondents who else will be participating and what will happen to the data. Thank the respondents in advance for their participation.

5. ***Pretest the questionnaire for readability, comprehension, and ease of completion.*** Make sure there is adequate space for responses and make refinements as necessary.

6. ***Distribute the questionnaires.***

7. ***Try to summarize the information as you receive completed questionnaires.***

8. ***Publish the results and outcomes, as appropriate.*** Thank the respondents.

FOR MORE HELP WITH
QUESTIONNAIRES AND SURVEYS:

See your TQM coordinator.

TIPS

DO...

☺ word the questions clearly and concisely.

☺ design short and easily-completed questionnaires.

☺ be very clear about the purpose of the survey.

☺ be careful not to create unrealistic expectations among respondents.

☺ consider interviews and check sheets as alternatives to questionnaires.

☺ be consistent with the "Paper Reduction Act" regulations (the TQM office can advise you).

☺ have someone who is not intimately involved in the activity read your questionnaire, looking especially for clarity and lack of bias.

☺ determine whether you need OMB approval for your survey

MORE TIPS

TRY TO AVOID...

☹ double-barreled questions ("and or "or").

☹ leading questions.

☹ questions that start with "As you know...", "Many people...", "Experts say...", etc.

☹ embarrassing questions or questions that might elicit a negative response.

☹ qualifiers, such as "frequently," most," and "seldom".

☹ more than one scoring or answering method.

☹ technical jargon.

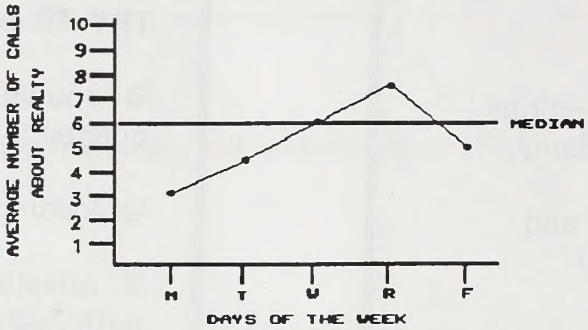
☹ questions that don't relate to the stated purpose.

☹ "nice to know" questions.

☹ one-word questions.

☹ questions that reference previous questions and speculative questions.

RUN CHART



PURPOSE:

To observe changes over time with reference to the data median.

PROCEDURES:

1. ***Draw a graph.***

2. ***List days, dates, months, or years along the X-axis of the graph.***

3. ***List values along the y-axis.***

4. ***Plot the observations, and connect the data points.***

5. ***Determine the median.*** The median is the point above and below which an equal number of observations fall.

6. ***Plot the median on the graph.***

FOR MORE HELP WITH RUN CHARTS:

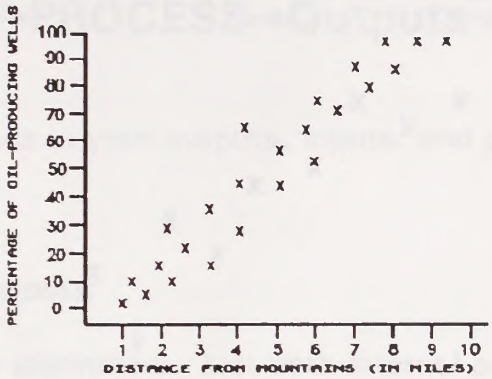
The Memory Jogger, pp. 30 - 35.

TIPS

▹ Be certain of the difference between a median and a mean (which is the average of the values of the observations).

▹ Pay attention to the sequence of the data, since change over time is being measured.

SCATTER DIAGRAMS



(the graph above illustrates a positive relationship)

PURPOSE:

To determine whether a correlative relationship between two variables exists.

PROCEDURES:

1. ***Draw a graph.***
2. ***List variable ranges along X and Y axes.***
3. ***Plot the data points.***
4. ***If data points repeat, circle them as many times as necessary.***

FOR MORE HELP WITH SCATTER DIAGRAMS:

The Team Handbook, p. 2-36

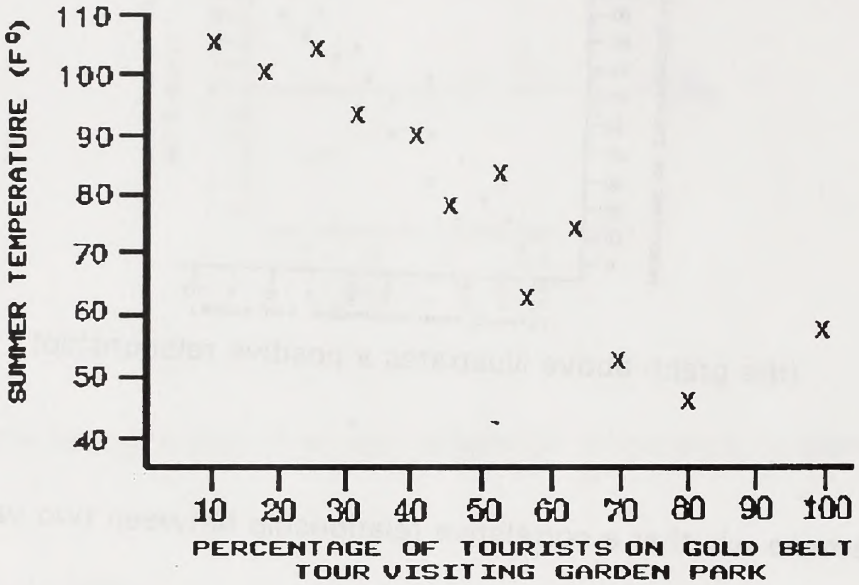
The Memory Jogger, pp. 44 - 50.

TIPS

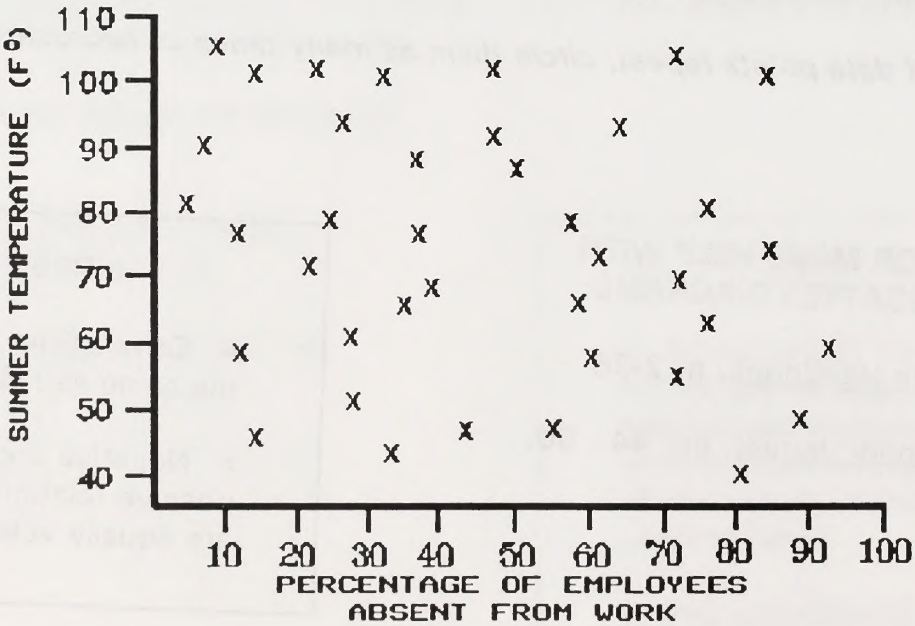
▹ *Correlations* are not the same as *causes*.

▹ Negative and positive relationships are equally valid.

SCATTER DIAGRAM SHOWING NEGATIVE RELATIONSHIP



SCATTER DIAGRAM SHOWING NO RELATIONSHIP



SIPOC MODEL

SUPPLIERS→Inputs→PROCESS→Outputs→CUSTOMER

PURPOSE:

To identify weaknesses in your outputs, inputs, and processes.

PROCEDURES:

1. ***Customers and outputs:***

   a. ***Identify your customers.*** List both internal and external ones.

   b. ***Identify the outputs that you provide for each customer.*** Decide which ones are most important and how you know this.

   c. ***Determine how you measure the degree to which your outputs satisfy the customers' requirements.*** Is this based on data?

   d. ***Identify the feedback that you receive from the customer.***

2. ***Process:***

   a. ***For each important output, identify the processes that you go through to provide the customer with the required output.***

3. ***Suppliers and inputs:***

   a. ***Identify your suppliers and inputs.*** List both internal and external ones.

   b. ***Identify the inputs that you require from each supplier in order to support your processes.***

   c. ***Determine whether the suppliers are aware of your input requirements and whether the input requirements are clearly defined.***

   d. ***Determine how you know how well the suppliers are satisfying your input requirements.*** How is this measured? Is the measurement based on data?

   e. ***Identify what feedback you provide your suppliers.***

SIPOC ANALYSIS WORKSHEET

PART 1: CUSTOMERS AND OUTPUTS

List your customers and what outputs each requires from you. How do you measure each output?

CUSTOMERS	OUTPUTS	MEASUREMENT
• Other resource specialists who have projects that might adversely affect BLM land	• "Archaeological clearances"	• Signed letter from State Historic Preservation Officer (SHPO)
• BLM management	• Compliance with laws, policies, and regulations	• Whether our resource area stays out of trouble
• SHPO	• Complete and accurate archaeological survey reports and site forms	• Survey report reviews by the SHPO
• Archaeological contractors	• Fieldwork authorizations	• None
	• Prompt review of their reports and SHPO consultation	• Signed letter from SHPO

SIPOC ANALYSIS WORKSHEET

PART 2: PROCESSES

For each key output, list processes you perform. A process defines the things that you do in order to provide the required output. Sometimes the same process will address more than one key output.

KEY OUTPUT	PROCESS
• "Archaeological clearance"	1. Receive request for archaeological survey. 2. Do a literature review. 3. Do the fieldwork. 4. Complete the report and site forms (if necessary) 5. Prepare letter to SHPO, have it signed by area manager, and send to SHPO. 6. After receiving letter back with SHPO signature, make a copy for the party who requested the survey.
• Complete and accurate reports and site forms.	1. Keep complete and precise field notes. 2. Fill in information on survey report checklist. 3. Run survey report macro and insert information from survey report checklist. 4. Complete site forms. 5. Edit and proofread.

SIPOC ANALYSIS WORKSHEET

PART 3: INPUTS AND SUPPLIERS

For each of your key suppliers, list the inputs that you require from suppliers to operate the process. List the suppliers and how their inputs are measured.

PROCESS	INPUT	SUPPLIERS AND MEASUREMENTS
"Archaeological clearance"	• completed inventory request	• resource specialists with projects/is request complete?
	• escort to project area	• resource specialists with projects/were they available if I needed them?
Completing reports and site forms	• guidelines to follow for doing reports and site forms	• SHPO/do they have guidelines established?
	• technical assistance	• SHPO/can they help me?
		• District archaeologist/can he/she help me?
		• BLM State Archaeologist/can he/she help me?

SIPOC TIPS AND FURTHER INFORMATION

FOR MORE HELP WITH SIPOC COMPONENTS:

Use the SIPOC Analysis worksheets in Appendix I.

See your TQM coordinator.

TIPS

▹ Be as thorough as possible; generalize as little as you are able.

▹ Remember that the purpose of a SIPOC model is to help you to *narrow* your problem; don't panic if you discover that more than one process is involved.

TESTING THE PROPOSED SOLUTION

PURPOSE

To document and test the proposed solution.

PROCEDURES

1. ***List the solution that you plan to test.***

2. ***Describe the test in general terms.***

3. ***List the type of data you will need to perform the test, the source of the data, and the tools you will use to analyze them.*** You may include comments and notes in this section.

4. ***Identify the tasks that need to be performed ("Specific Actions"), who will perform them, and the deadline for their completion.*** Be certain that you have the assent of the person assigned the task; do not assign them in someone's absence unless they have authorized you to do so.

5. ***When the test is completed, analyze the results, using the "Analysis of Test Results Worksheet":***

   a. List each test, what the results were and whether it met expectations. If the test was successful, go on to the Action Plan tool.

   b. If the test did not meet expectations, determine whether you want to redo the test or design a new test. If you decide to design a new test, determine the type, and to back to Step 1 (above).

FOR MORE HELP WITH TESTING THE PROPOSED SOLUTION:

Use the Testing the Proposed Solution and Analysis of Test Results Worksheets found in Appendix I.

See your TQM coordinator.

TIPS

▷ Keep your documentation worksheets neat and organized, so that they can be used in presentations to management.

TESTING THE PROPOSED SOLUTION WORKSHEET

SOLUTION TO BE TESTED:

Receptionist notifies addressee of fax.

GENERAL DESCRIPTION OF TEST:

When faxes come in, they will not be sent through normal mail routing, but will be forwarded directly to the addressee, who will then be responsible for routing.

DATA GATHERING AND ANALYSIS:

TYPE OF DATA	SOURCE	TOOLS	COMMENTS
1. Amount of time it takes for faxes to reach addressee.	Addressee	Survey form, data gathering, time order plot	
2. Whether appropriate people are receiving the information	Addressee, managers	Survey form, data gathering	

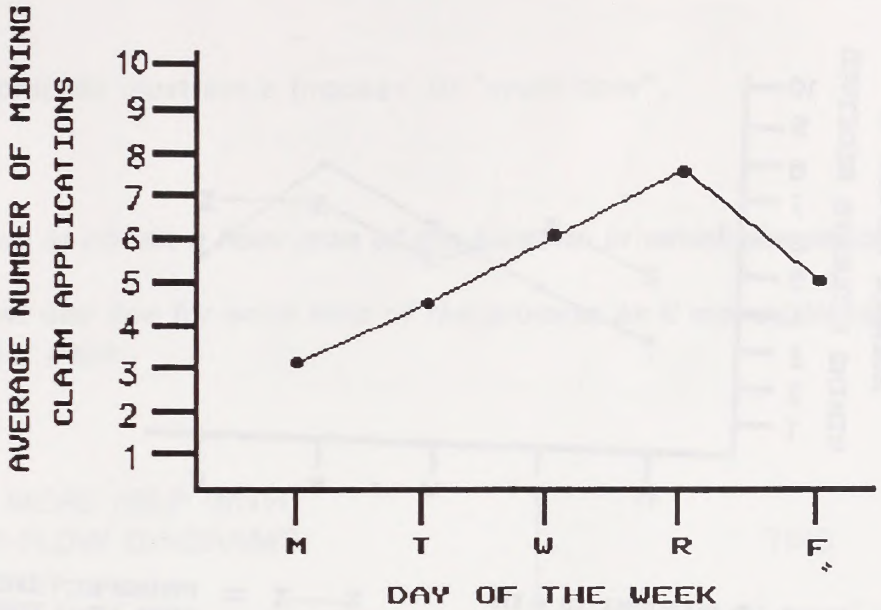
SPECIFIC ACTIONS:

ACTION	RESPONSIBILITY	DATE NEEDED
1. Design survey form for addressee	Herman Finstermacher	11/12/93
2. Design log sheet for receptionist	Joe Schmoe	11/12/93
3. Design survey form for managers	Herman Finstermacher	11/12/93
4. Make Time Order Plot of log sheet data when test is over	Sue Schmoo	2/15/94

ANALYSIS OF TEST RESULTS WORKSHEET

TEST	RESULTS	DID THE RESULTS MEET EXPEC-TATIONS?	REDO TEST?	NEW TEST?	NEW TEST TYPE
Receptionist notifies addressee of fax.	Faxes are reaching addressees faster.	YES	NO	NO	NA
Appropriate people are receiving information.	Information is not always getting to appropriate people.	NO	YES	NO	

TIME ORDER PLOT



PURPOSE:

To evaluate data trends over time.

PROCEDURES:

1. ***Draw a graph.***

2. ***Array time variables along the X-axis and measurement variables along the Y-axis.***

3. ***Plot the data points and connect them.***

FOR MORE HELP WITH
TIME ORDER PLOTS:

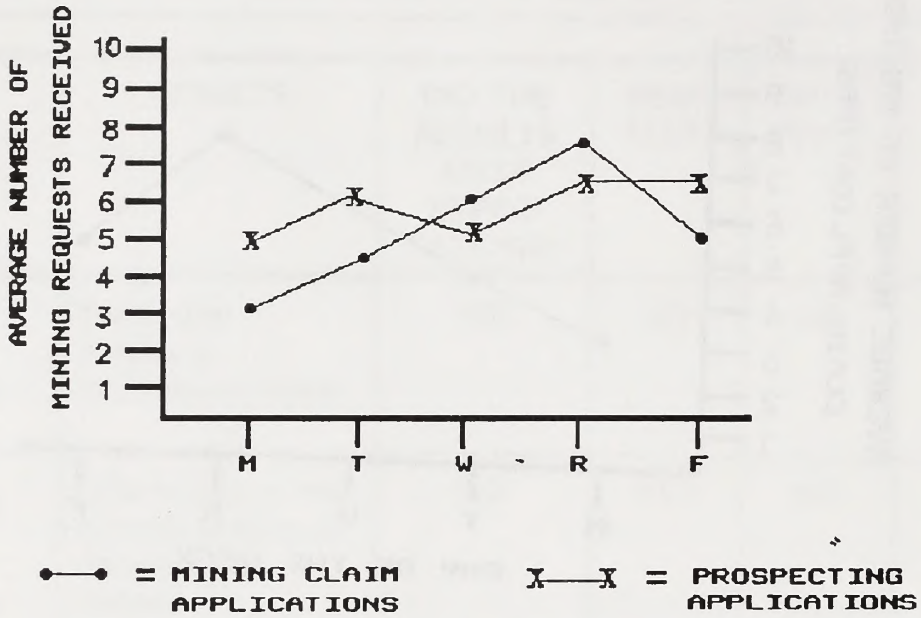
The Team Handbook, pp. 2-32 - 2-33

TIPS

▹ More than one data set at a time can be illustrated (see next page).

▹ Clearly mark the inclusive time period and the measurement unit.

TIME ORDER PLOT: TWO DATA SETS



WORK-FLOW DIAGRAM

PURPOSE:

To graphically illustrate a process, or "work flow".

PROCEDURES:

1. ***Draw or obtain a floor plan of the location in which the process takes place.***

2. ***Draw one line for each step of the process as it moves through the floor plan (see next page).***

FOR MORE HELP WITH WORK-FLOW DIAGRAMS:

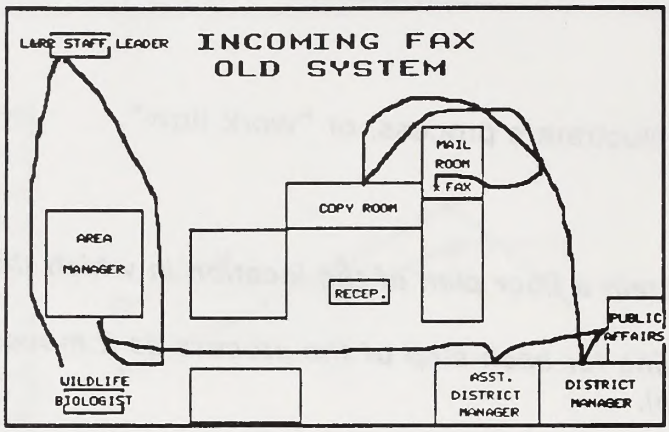
The Team Handbook, pp. 2-22 - 2-23

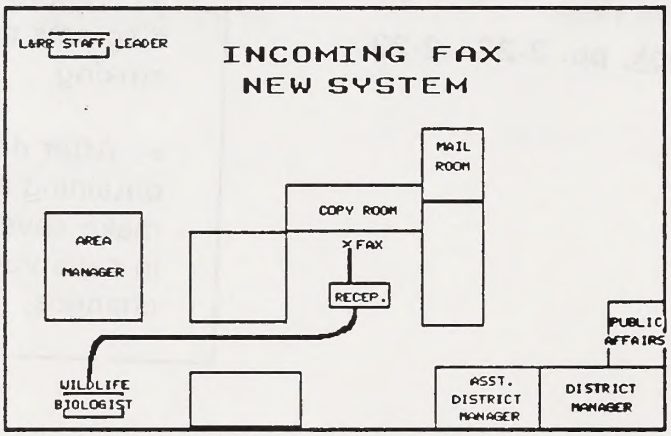
TIPS

▹ "Before" and "after" diagrams can be very striking.

▹ After drawing or obtaining a floor plan, make several xerox copies in case you make changes.

WORK-FLOW DIAGRAM: EXAMPLES





VIII: WORKSHEETS

SECTION VIII: WORKSHEETS

THE FOLLOWING WORKSHEETS ARE PROVIDED FOR YOU TO REPRODUCE AND USE ON YOUR QUALITY IMPROVEMENT PROJECT.

ACTION PLAN WORKSHEET

HOW WILL THE NEW SYSTEM WORK?

WHAT CHANGES WILL BE NECESSARY?

A. METHODS AND PROCEDURES

B. ADDITIONAL TRAINING

C. INCREASED OR REDISTRIBUTED FUNDING

D. EQUIPMENT

E. PERSONNEL

TIMETABLE AND ASSIGNMENTS

TASK	PERSON RESPONSIBLE	DEADLINE

ANALYSIS OF TEST RESULTS WORKSHEET

TEST	RESULTS	DID THE RESULTS MEET EXPEC-TATIONS?	REDO TEST?	NEW TEST?	NEW TEST TYPE

DECISION MATRIX WORKSHEET

IDEA	WT. =		WT. =		WT. =		WT. =		TOTAL WEIGHTED RATING FOR EACH IDEA
	ID RTG	WTD RTG	ID RTG	WTD RTG	ID RTG	WTD RTG	ID RTG	WTD RTG	

DECISION MATRIX WORKSHEET

	WT. =		WT. =		WT. =		WT. =		
	ID RTG	WTD RTG	ID RTG	WTD RTG	ID RTG	WTD RTG	ID RTG	WTD RTG	

MID-MEETING EVALUATION WORKSHEET

Brief Stop-Action Check Evaluation

To help improve our productivity, please respond to the following questions:

1. How do you feel about how you are being listened to?

☐ well satisfied ☐ just satisfied ☐ dissatisfied

Please comment on why you checked the box you did:

2. How fully do you think you have been listening to and using the ideas of the others?

☐ fully ☐ pretty well ☐ not too well ☐ poorly

Please comment on why you checked the box you did:

3. Please share your data with each other and agree on an idea or two on how you might improve the group's work as you continue.

Communication and Group Productivity: A Quick Check

1. What barriers to communication, if any, seem to be operating in this meeting?

2. What can be done to improve group productivity now?

3. Please share your thoughts on the two questions and decide what the group might do to improve the way you work and think together.

MEETING EVALUATION WORKSHEET

End-of-Meeting Feedback Thoughts

1. How do you feel about what we accomplished in this meeting?

☐ well satisfied ☐ just satisfied ☐ dissatisfied

Please comment on why you checked the box you did:

2. How do you feel about the way we worked on our tasks?

☐ well satisfied ☐ just satisfied ☐ dissatisfied

Please comment on why you checked the box you did:

3. What do you suggest for our next meeting? Procedures? Agenda? Physical arrangements? Leadership? or anything else.

OVERALL EVALUATION

Our meeting today was:

Very Focused	1	2	3	4	5	6	Rambling
Energetic	1	2	3	4	5	6	Lethargic

I would characterize our methods as:

Scientific Method	1	2	3	4	5	6	Shooting from the hip
Cooperative	1	2	3	4	5	6	Divisive

MISTAKE-PROOFING WORKSHEET: PROCESS ANALYSIS

PROCESS STEPS	POSSIBLE ERRORS	LIKELIHOOD	SEVERITY	ACTION?

MISTAKE-PROOFING WORKSHEET: MISTAKE-PROOFING METHODS

POSSIBLE ERROR ACTIONS	IDEAS FOR CORRECTION	ADVANTAGES	DISADVANTAGES

MISTAKE-PROOFING WORKSHEET: MISTAKE-PROOFING METHODS

POSSIBLE ERROR ACTIONS	IDEAS FOR CORRECTION	ADVANTAGES	DISADVANTAGES

PRIORITIZATION OF PROBLEMS WORKSHEET

PROBLEM	PROBABILITY OF OCCURRENCE	SEVERITY	ACTION ITEM?	ASSIGNED FOLLOWUP

SIPOC ANALYSIS WORKSHEET

PART 1: CUSTOMERS AND OUTPUTS

List your customers and what outputs each requires from you. How do you measure each output?

CUSTOMERS	OUTPUTS	MEASUREMENT

SIPOC ANALYSIS WORKSHEET

PART 2: PROCESSES

For each key output, list processes you perform. *A process defines the things that you do in order to provide the required output. Sometimes the same process will address more than one key output.*

KEY OUTPUT	PROCESS

SIPOC ANALYSIS WORKSHEET

PART 3: INPUTS AND SUPPLIERS

For each of your key suppliers, list the inputs that you require from suppliers to operate the process. List the suppliers and how their inputs are measured.

PROCESS	INPUT	SUPPLIERS AND MEASUREMENTS

TESTING THE PROPOSED SOLUTION WORKSHEET

SOLUTION TO BE TESTED:

GENERAL DESCRIPTION OF TEST:

DATA GATHERING AND ANALYSIS:

TYPE OF DATA	SOURCE	TOOLS	COMMENTS

SPECIFIC ACTIONS:

ACTION	RESPONSIBILITY	DATE NEEDED

TESTING THE PROPOSED SOLUTION WORKSHEET

SOLUTION TO BE TESTED:

GENERAL DESCRIPTION OF TEST:

DATA GATHERING AND ANALYSIS:

TYPE OF DATA	SOURCE	TOOLS	COMMENTS

SPECIFIC ACTIONS:

ACTION	RESPONSIBILITY	DATE NEEDED

SECTION IX: TABLES AND ADDITIONAL STATISTICAL METHODS

TABLE 1: TABLE OF FACTORS FOR CONTROL CHARTS

NUMBER OF OBSERVATIONS IN SUBGROUP	MEAN CHART: A_2	INDIVIDUALS CHART: E_2	RANGE CHART: D_3	D_4	STANDARD DEVIATION: d_2
2	1.880	2.660	0	3.267	1.128
3	1.023	1.772	0	2.574	1.693
4	0.729	1.457	0	2.282	2.059
5	0.577	1.290	0	2.114	2.326
6	0.483	1.184	0	2.004	2.534
4	0.419	1.109	0.076	1.924	2.704
8	0.373	1.054	0.136	1.864	2.847
9	0.337	1.010	0.184	1.816	2.970
10	0.308	0.975	0.223	1.777	3.078

TABLE 1: TABLE OF FACTORS FOR CONTROL CHARTS

TABLE 2: IDEAS FOR GENERATING RANDOM NUMBERS

IDEA	ADVANTAGES	DISADVANTAGES
Use a random number generator on a calculator	1. Very easy 2. Trustworthy (for randomness)	1. Must have a scientific calculator 2. Often have to multiply by 10 or 100
Use a multiple-sided die	1. Easy 2. Trustworthy (for randomness)	1. Must find a multiple-sided die 2. Have to throw twice for a two-digit number 3. Time-consuming
Pull numbers out of a container	1. Easy	1. Might be biased 2. Time-consuming
Generate by computer	1. Trustworthy for randomness	1. Might be complicated to set up

TABLE 2: IDEAS FOR GENERATING RANDOM NUMBERS

IDEA	ADVANTAGES	DISADVANTAGES
Use a random number generator on a calculator	1. Very easy 2. Trustworthy (for randomness)	1. Must have a scientific calculator 2. Other than 10 requiring an 10 or (10)
Use a multiple-sided die	1. Easy 2. Trustworthy (for random nature)	1. Must have a multiple sided die 2. Have to throw dice for a "random" number 3. Time-consuming
Put numbers out of a cookie jar	1. Easy	1. Might be hassled 2. Time-consuming
Generate by computer	1. Trustworthy (for randomness)	1. Might be complicated to set up

COMPUTING STANDARD DEVIATIONS

METHOD 1 (if you have not done related control charts):

1. List your data in a column labeled "X". You will be using the following formula: $s = \sqrt{\Sigma(x-\bar{x})^2/(n-1)}$

2. Figure the mean ($\bar{X}$) of your data.

3. Adjacent to the data column, label a new column "X - $\bar{X}$", subtract the mean from each data point, and list the result.

4. Label a third column "$(X - \bar{X})^2$", square each result in the X - $\bar{X}$ column, and list the new result.

5. Add the results in the $(X - \bar{X})^2$ column ($\sum$).

6. Divide the sum ($\sum$) of the $(X - \bar{X})^2$ by the total number of data points minus 1 (n-1).

7. Figure the square root of the result of number 6.

EXAMPLE

X	X - $\bar{X}$	$(X - \bar{X})^2$
3	-2.2	4.84
7	1.8	3.24
9	3.8	14.44
4	-1.2	1.44
3	-2.2	4.84

$\bar{X} = 5.2$; $\sum(X - \bar{X})^2 = 28.8$; $28.8/4 = 7.2$; $\sqrt{7.2} = 2.68 = s$

COMPUTING STANDARD DEVIATIONS

METHOD 1 (if you have not done manual control charts):

1. List your data in a column labeled "X". You will be using the following formula: $s = \sqrt{\Sigma(X - \bar{X})^2/(n-1)}$

2. Figure the mean ($\bar{X}$) of your data.

3. Adjacent to the data column, label a new column "$X - \bar{X}$", subtract the mean from each data point, and list the result.

4. Label a third column "$(X - \bar{X})^2$", square each result in the $X - \bar{X}$ column, and list the new result.

5. Add the results in the $(X - \bar{X})^2$ column (Σ).

6. Divide the sum (Σ) of the $(X - \bar{X})^2$ by the total number of data points minus 1 ($n-1$).

7. Figure the square root of the result of number 6.

EXAMPLE:

X	$X - \bar{X}$	$(X - \bar{X})^2$
1	-2.2	4.84
7	1.8	3.24
9	3.8	14.44
4	-1.2	1.44
2	-3.2	4.84

$\bar{X} = 5.2$; $\Sigma(X - \bar{X})^2 = 28.8$; so $s/n = 7.2$; $\sqrt{7.2} = 2.68 = s$

METHOD 2 (if you have done related control charts):

Follow the formula: $s = \bar{R}/d_2$

where $\bar{R}$ is the mean from your range chart, and d_2 is a constant found in Table 1.

Empowerment: The delegation of responsibility and authority to do work or make decisions about that work.

Expectation: An anticipated result or hope. Sometimes it is an unspecified requirement that is assumed to be known.

Facilitator: See Team Roles.

Goal: A desired purpose, result, or achievement. It is usually broader in scope and of longer term than an objective.

Issue: A concern that requires a decision and/or action.

Leader (Team): See Team Roles.

Mean ($\bar{X}$): A mean is a sum all of the values of a data set, divided by the total number of observations. Means are also known as "averages".

Median: The point above and below which an equal number of observations fall.

Objective: A specific desired purpose, result, or achievement. It is more specific, detailed, and of shorter term than a goal.

Observation: A single piece of data. When plotted on a graph, they are known as data points.

Performance Measurement: A metric or other descriptor that monitors how well activities or people are completing goals, objectives, or requirements.

Problem: An issue that continues to occur.

Process: A multiple-step, cyclical method for completing work that has easily-defined starting and ending points. All work can be defined in terms of processes. A process can be defined, measured, controlled, and improved, has measurable inputs, and results in measurable outputs or outcomes. A process should add value.

Process Owner: The person who has authority to manage a specific process and responsibility for its overall performance.

Project: An undertaking that has defined goals and specific starting and ending dates.

Empowerment: The delegation of (within safety) and authority to do work or make decisions around that work.

Expectation: An anticipated result or image. Sometimes it is an unspecified measurement that is assumed to be known.

Facilitator: See Team Roles.

Goal: A desired purpose, result, or achievement. It is usually broader in scope and of longer term than an objective.

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Mean (X̄): A mean is a sum of all of the values of a data set, divided by the total number of observations. Means are also known as "averages".

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Team (Team): The delegation of (within safety) and authority to do work or make decisions around that work.

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Process Owner: The person who has authority to manage a specific process and responsibility for its overall performance.

Project: An undertaking that has defined goals and specific starting and ending dates.

Requirements: Specific attributes or needs.

Stakeholder: Any person who has a vested interest in an issue, problem, process, system, or business. This includes the process owner, worker, customer, supplier, or shareholder.

Suppliers: Providers of the inputs required to do a job or work process or are organizations/individuals from whom we purchase materials, information, or services. Suppliers can be either internal or external to the organization.

System: Several interrelated processes. For brevity, "process" is sometimes used to mean "system".

Team: A group of people who come together for a common purpose.

Team Member: See Team Roles.

Team Roles:

Advisor May or may not be the person who designed the project. The advisor created the vision for the project and is a source of ongoing energy. He or she plays a major role in selling the project and obtaining a sponsor. An advisor is also someone of authority who sanctions the project and can provide or negotiate the necessary resources. Many projects may require representation by various departments, divisions, or groups. There may be more than one advisor.

Leader Keeps the team focused on its goals and objectives. The leader is the communication link between the team, advisor, Quality Board, other projects, and the rest of the organization.

Facilitator Works with the team to optimize their effectiveness. This could include doing team building and training. He or she attends team meetings to help with group process issues and problems.

Team Member A participant in team activities. Administrative responsibilities include team administrator (minutes, notices, etc.) and gatekeeper (enforces rules, times, etc.)

Value: A variable numerical quantity; each numerical observation.

X: GLOSSARY

SECTION X: GLOSSARY

Advisor:	see Team Roles.
Attributes:	Data that are counted.
Average:	See "Mean".
Benchmarking:	Products, services, and practices are compared with the toughest competitors or those companies recognized as industry leaders.
Boundary Conditions:	Boundary conditions specify the constraints and limitations that must be considered before a decision is made or an action taken. They define requirements and expectations, such as responsibility and authority, resources, time, schedule, and frequency.
Consensus:	A group reaches consensus when all members agree upon a single alternative, and each group member agrees that they understand all points of view. Each team member also agrees that, whether they agree with it or not, they support it because it was reached fairly and openly, and it is the best solution for the team at the time.
Continuous Improvement:	A strategy to ensure that all aspects of systems or processes are monitored and improved continuously.
Contract:	An agreement on roles, responsibilities and behaviors that can be expected from the team leader, facilitator, recorder and team members. Also, an agreement on how to handle thorny or difficult issues should they arise.
Culture:	The integration of values, beliefs, sentiments, and attitudes that result in behaviors, and practices that characterize the work environment.
Customers:	The recipients of the outputs of work or the purchaser of products and/or services. Customers can either be internal or external to the organization.
Data and Information:	A set of numbers or facts that are presented in a descriptive or summarized format, frequently referred to as data.

SECTION X: GLOSSARY

Advisor:	see Team Roles
Attributes:	Data that are counted.
Average:	See "Mean"
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Expectation:	An anticipated result or hope. Sometimes it is an unspecified requirement that is assumed to be known.
Facilitator:	See Team Roles.
Goal:	A desired purpose, result, or achievement. It is usually broader in scope and of longer term than an objective.
Issue:	A concern that requires a decision and/or action.
Leader (Team):	See Team Roles.
Mean ($\bar{X}$):	A mean is a sum all of the values of a data set, divided by the total number of observations. Means are also known as "averages".
Median:	The point above and below which an equal number of observations fall.
Objective:	A specific desired purpose, result, or achievement. It is more specific, detailed, and of shorter term than a goal.
Observation:	A single piece of data. When plotted on a graph, they are known as data points.
Performance Measurement:	A metric or other descriptor that monitors how well activities or people are completing goals, objectives, or requirements.
Problem:	An issue that continues to occur.
Process:	A multiple-step, cyclical method for completing work that has easily-defined starting and ending points. All work can be defined in terms of processes. A process can be defined, measured, controlled, and improved, has measurable inputs, and results in measurable outputs or outcomes. A process should add value.
Process Owner:	The person who has authority to manage a specific process and responsibility for its overall performance.
Project:	An undertaking that has defined goals and specific starting and ending dates.

Empowerment: The delegation of responsibility and authority to do work or make decisions about their work.

Expectation: An anticipated result or hope. Sometimes it is an unspecified requirement that is assumed to be known.

Facilitator: See Team Notes.

Goal: A desired purpose, result, or achievement. It is usually broader in scope and of longer term than an objective.

Issue: A concern that requires a decision and/or action.

Leader (Team): See Team Roles.

Mean (X̄): A mean is a sum of all of the values of a data set, divided by the total number of observations. Means are also known as "averages".

Median: The point above and below, which an equal number of observations fall.

Objective: A specific desired business result, or achievement. It is more specifically defined, and of shorter term than a goal.

Observation: A single piece of data. When plotted on a graph, they are known as data points.

Performance Measurement: A matrix or other accounting that monitors how well functions or groups are completing goals, objectives, or requirements.

Problem: An issue that continues to occur.

Process: A multiple step, cyclic or method for accomplishing work that has easily defined starting and ending points. All work can be defined in terms of processes. A process can be defined, measured, controlled, and improved, but measures, and results in tangible outputs or outcomes. A process adds value.

Process Owner: The person who has authority to manage a process and responsibility for its overall performance.

Project: An undertaking that has defined goals and specific starting and ending dates.

Root Cause:

Requirements: Specific attributes or needs.

Stakeholder: Any person who has a vested interest in an issue, problem, process, system, or business. This includes the process owner, worker, customer, supplier, or shareholder.

Suppliers: Providers of the inputs required to do a job or work process or are organizations/individuals from whom we purchase materials, information, or services. Suppliers can be either internal or external to the organization.

System: Several interrelated processes. For brevity, "process" is sometimes used to mean "system".

Team: A group of people who come together for a common purpose.

Team Member: See Team Roles.

Team Roles:

Advisor May or may not be the person who designed the project. The advisor created the vision for the project and is a source of ongoing energy. He or she plays a major role in selling the project and obtaining a sponsor. An advisor is also someone of authority who sanctions the project and can provide or negotiate the necessary resources. Many projects may require representation by various departments, divisions, or groups. There may be more than one advisor.

Leader Keeps the team focused on its goals and objectives. The leader is the communication link between the team, advisor, Quality Board, other projects, and the rest of the organization.

Facilitator Works with the team to optimize their effectiveness. This could include doing team building and training. He or she attends team meetings to help with group process issues and problems.

Team Member A participant in team activities. Administrative responsibilities include team administrator (minutes, notices, etc.) and gatekeeper (enforces rules, times, etc.)

Value: A variable numerical quantity; each numerical observation.

XI: BIBLIOGRAPHY

SECTION XI: BIBLIOGRAPHY

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